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COUNT DE LESSEPS.

COUNT FERDINAND DE LESSEPS died at the Chateau . Chesnaye, December 7, 1894. Count de Lesseps died lmost in poverty at the age of 89 years. For the last hree years the old man was in a feeble condition both as egards body and mind. Count de Lesseps, born in 1805, as educated for the diplomatic service, and at the age f twenty he became the assistant of his uncle, who as then French charge d'affaires at Lisbon. In 1833 e Lesseps was appointed consul at Cairo, where he was favorably noticed for his conduct during the plague in 1834-35, and for his bravery he received the medal of the Legion of Honor. That De Lesseps was a skillful diplomat is shown by his bringing about a reconciliation between the Viceroy of Egypt and the Sultan of Turkey. In 1834 De Lesseps went to Rotterdam as consul. While in Holland he had ample time to study the canal system of that country. From Rotterdam De Lesseps was sent to Malaga, then to Barcelona, and in 1848 he was promoted to be French minister at Madrid. He was next sent on a mission to Rome, but as he did not give satisfaction, he was recalled. He left Paris and bought the Chateau de la Chesnaye. For many years he had the subject of a canal between the Mediterranean and the Red Sea under consideration, but it was not until 1854 that his plans took definite shape. De Lesseps found supporters in Said Pasha, the Viceroy of Egypt, and in the Empress Eugenie of France, who persuaded Napoleon III. to do all in his power to promote the plan. After surmounting many obstacles in the way of getting the permission to carry on the enterprise and in raising

BORN NOVEMBER, 1805. DIED DECEMBER, 1894.

M. FERDINAND DE LESSEPS.

money, work was actually started in 1859. Ten years later, in 1869, it was opened with imposing ceremonies by the Empress Eugenie herself, in the presence of several sovereigns and many eminent men. The brilliant success which had crowned the enterprise quite turned the head of the great engineer, who then conceived the idea of piercing the Isthmus of Panama. In the year 1879 a congress was convened in Holland to discuss the feasibility of the enterprise. It was at last determined to dig a canal from Colon to the Bay of Panama. The company was called "La Compagnie Universelle du Canal Interoceanique de Panama." De Lesseps was at this time 74 years of age and he no longer possessed the mental vigor and physical energy which had distinguished him in his earlier days. Money was hard to raise and unscrupulous men obtained executive offices in the company, and at last the great financial crash came which brought ruin to thousands. The subsequent trials prove that in the later years of the enterprise the old count had been little more than a figurehead. When the crash came De Lesseps was taken to his country house, completely broken in body and mind. While he was passing away the days at La Chesnaye in a kind of stupor the courts at Paris were handing down decrees of fine and imprisonment against the old man who was once known as the "Great Frenchman." But for once justice was tempered with mercy and Count de Lesseps never knew of his disgrace. He visited the United States twice, once in 1880 and the second time at the unveiling of the Statue of Liberty, in the harbor of New York. For our engraving we are indebted to Black and White.

[From the Independent.]

THE TRANSANDINE RAILWAY AND INTERANDINE TRUNK LINES.

By Courtenay de Kalb.

To the world at large there is just one great Andean railroad. It matters not that the frowning obstructions of this mighty range have three times already been overcome by the genius of railway engineers, nor that the locomotive whistle has for many a year echoed among these snow clad peaks; the Andean road which the world knows is that one which has claimed for itself the title of Transandine, which is destined to break the barrier between the vast treeless pampas of Argentine and the pleasant valleys of Chile, and to open another way from ocean to ocean. It will be a link in a new route from Europe to the South Seas, a shorter way from England to New Zealand. It will also be of incalculable advantage through saving at least twelve days in the journey from Europe to the west coast of South America. Strange as may seem, it takes no longer to go from New York to Santiago, Chile, to-day via Liverpool and Buenos Ayres, and thence across the continent, than to go by way of Panama, and, considering the usual delays on the Isthmus, there is apt to be a saving in time by the Buenos Ayres route. Furthermore, the expense is almost exactly the same, through tickets being now on sale from London to Valparaiso at so small a sum as $200.

So far as distance is concerned the Transandine Railroad is almost complete. The total length of the Argentine and Chilean sections is 150 miles, of which only 22 miles on the Chilean and 21 miles on the Argentine side remain unfinished.

But in these 43 miles lie all the serious difficulties of the undertaking, serious not from an engineering standpoint, but because of the great sum of money needed for the driving of nine and a half miles of tunnels. One of these, at Portillo, is spiral, with a radius of curve 656 feet in length, a circumstance of some interest, but by no means remarkable in these days. When that talented American, William Henry Cilley, conceived and executed the first spiral tunnel in the world on the Lima and Oroya Railroad in Peru, lengthening his line thus underground in order to overcome the difficulty of excessive grade on the surface, it was a brilliant enginering feat; but where one has shown the way it is easy enough for others to follow. These tunnels on the Transandine Railroad will be remarkable, however, for the unique purpose which they will serve.

In fact, these nine miles of tunnels could be reduced to less than two miles; but they have been adopted to avoid blockade by snow in the winter, being practically little more than permanent snowsheds, absolutely safe at all times against destruction by avalanches. For long distances they will run so near to the outer slope of the mountains that short tunnels, which the contractors denominate "windows," will be opened at frequent intervals, enabling work to be carried on from numerous "headings," and providing better ventilation when the main tunnels are complete. The summit level of the road will also be in a tunnel somewhat more than three miles in length and 10,460 feet above the sea.

The configuration of the Andes at this point is very different from that further north. Instead of being broken into several parallel chains, such as we find all the way from Panama down into Bolivia, there is here a single lofty range, with a base less than 100 miles in width, towering more than 20,000 feet into the clouds. Mendoza, the starting point of the Argentine section, is only 2,376 feet above the sea, and Santa Rosa de los Andes, the terminus of the Chilean section, is at an elevation of only 2,739 feet.

Within forty miles the Chilean section ascends 7,721 feet, being an average of 193 feet to the mile; but, unfortunately, there is no such equal distribution of the grade as this, and for a very considerable distance the ascent is eight feet in every hundred, or 422 feet to the mile. This necessitates the use of the rack system, and locomotives have been constructed so as to work in the ordinary way by adhesion on the flatter gradients and by rack and pinion on the steep inclines.

The total distance from Buenos Ayres to Valparaiso by this route is 882 miles. Connection is made by the Buenos Ayres and Pacific Railway to Villa Mercedes, and thence by the Argentine Great Western Railway to Mendoza, the total distance from Buenos Ayres to Mendoza being 649 miles.

The Transandine Railway will carry one from Mendoza to Santa Rosa, another 150 miles, and the Chilean State Railway completes the journey to Valparaiso, 83 miles distant, or to Santiago, 80 miles to the southward. The schedule time across the continent, when the Transandine road is completed, will be about 51 hours. At present the trip would occupy three days, the gap between Punta de las Vacas on the Argentine side and Salto del Soldado, in Chile, having to be traversed on horseback; but the roads are now being improved, so that a stage coach line may be started during the present year; and the concessionaires of the railroad are about to build a first-class modern hotel in the very heart of the Andes for the accommodation of passengers in transit. The grandeur of the scenery is beyond description. The vision of such a mountain as Aconcagua, lifting its mighty mass of barren rock and gleaming snow to a height of 22,500 feet above the sea, must leave an impression of sublime and awful majesty upon the least susceptible brain which will endure forever.

There is no lessening of the scenic effect of these mountains by the elevation of the surrounding country. They spring from low plains on either side, and the Chilean slope is so extremely steep that one sees a continuous wall as far as the eye can reach, averaging more than 12,000 feet in height above the valley at its base.

We have seen that this Transandine Railway is destined to perform an important function in facilitating transit from Europe to countries bordering on the South Pacific; and it is evident that the beauties of the Andes, the healthfulness of the climate and an abundance of mineral springs possessing valuable medicinal qualities, will draw hither the habitual globe-trotting health and pleasure seeker, who is growing more numerous every year; but it is not directly for either of these things that this road is being built. For decades Chile has drawn immense numbers of cattle from Argentine, which have been driven at great risk and cost across the Andes by the same Uspallata Pass through which the railroad has been located. Also the Argentine provinces along the base of the Andes were accustomed to depend upon Chile for a large part of their supplies of manufactured goods, until the railroad system reaching west from Buenos Ayres changed the course of trade. Primarily, then, the Transandine Railway is being built in the interests of a cattle trade which from the beginning will amount to 40,000 head a year, yielding a gross income from transportation of nearly $400,000. Secondarily, it is expected to make Valparaiso once more the port of entry for the western provinces of Argentine, since it will cost less to ship by water around through the Straits of Magellan to Valparaiso and back across the mountains 230 miles, than to unload at Buenos Ayres and forward 649 miles by rail across the pampas, on the same principle that it will be cheaper to ship a ton of freight from Salt Lake City to San Francisco, and thence by the Nicaragua Canal to New York, than to send it straight across the continent.

The growing commercial movement in South America, which has elevated the Transandine Railway project in twenty years from a sort of romantic scheme to a practical necessity, has also led to the development of other railroad systems which forecast the future tendency of trunk line extensions in this southern continent. Just as the transcontinental system is now almost completed in obedience to the demands of commerce, so is a north and south connection, following the trend of the Andean valleys, indicated by many unfailing signs. The Argentine roads have extended almost to the frontier of Bolivia in the north, and efforts are now being made to prolong them until they shall form a junction with the Antofagasta and Bolivia Railway in this republic among the clouds. The latter road now traverses, in a north and south direction, the greater portion of the Bolivian highlands, and will soon be finished to the capital city of La Paz. A connection between La Paz and the Southern Railway of Peru, which climbs from Mollendo on the Pacific coast to the shores of Lake Titicaca, 12,500 feet above the sea, has long been contemplated; and the competition of the Antofagasta and Bolivia Railway will render such a line imperative to save the Peruvian road from a heavy loss of traffic.

Furthermore, the elevated region of Peru, which has now been penetrated by the Southern Railway, as well as by the Central (Lima and Oroya) Railway, will of necessity be traversed by subsidiary lines before many years have passed. In fact, a portion of such a system is already pledged by the contract between the government and the famous Peruvian corporation, which has assumed the national debt and taken control of the state railroads of the republic. It is evident that a direct connection by rail between Buenos Ayres and Peru is an event which will not long be deferred; and it is possible that the chain may soon be complete all the way from Buenos Ayres to Lima. Such a statement loses no weight from the circumstance that a decade, or even two decades, may elapse before this comes to pass.

Three decades ago there was hardly a mile of railroad in the whole of South America, while to-day the continent is nearly spanned and 19,000 miles of track are in operation.

Trade is already flowing in no mean volume along the lines which these future roads must follow, and now that the spirit of progress has seized upon the South Americans, industrial changes may be expected to ensue with ever-increasing rapidity.

The Intercontinental Railroad project, in spite of its visionary character, was not by any means devoid of a rational basis. There is warrant enough in the movement of traffic to-day for the construction of a considerable portion of this contemplated trunk line. Particularly is this true of that portion which would traverse Colombia and Ecuador. The valleys here trend north and south, rising toward the south into high plateaus. There is a wide diversity of climate, resulting in a diversity of products, which is extremely favorable for the development of a successful railroad system. At the northern extremity of this chain of valleys is the beautiful city of Cartagena, possessing a magnificent land-locked harbor, with thirty feet of water up to the wharves, which a North American company has recently constructed. It is the natural port for an immense area reaching as far south as Peru, and a trunk line from Cartagena southward would make of this city an important metropolis and port of entry for a large part of South America. In the olden time the great Camino Real, the King's Highway of South America, extended from Cartagena all the way to Peru and to what is now Bolivia. Vast quantities of treasure were brought thousands of miles over this road to the great Caribbean port for shipment to Spain. Such a repository of gold and silver as Cartagena then became naturally constituted a point of attraction for the buccaneers, whose undesirable attentions led to walling in the city and to the erection of extensive fortifications. The wall still endures almost intact, and the ruins of other structures of that turbulent period lend a peculiar charm to this historic city.

When the growth of commerce makes it once more the emporium of wealth, it will be found possessed of all those qualities so needful in a metropolis—a healthful climate, picturesque surroundings suitable for villa sites, and an enormous water frontage. The beginning of its new career has just been made. A railroad owned by North Americans has been built to the Rio Magdalena, which will divert the bulk of Colombian commerce through this long-neglected port. But this is not all, for the completion of this road means the giving of a port to the republic of Colombia. It is hard to conceive of a republic embracing half a million square miles of territory, endowed by nature with a lavish wealth of resources, blessed with every variety of climate, bordering on two oceans, and yet destitute of an available harbor. Such, however, has been the anomalous condition of Colombia until Cartagena was connected with the great river which forms the highway into the heart of the republic. While ships from all the world have been sailing past her coasts, Colombia has been cut off, isolated, as if she were a landlocked state. Development has, consequently, been retarded; but now the tide has turned. Projects for rail communication, which have been but dreams in the past, are assuming vitality, claiming the serious attention of serious men. And there is only one course which these roads can take. The route lies south, and link by link the chain will grow, until the old Camino Real shall be reproduced by a road of steel.

It is an interesting fact that commerce flows along this old mule road to-day from Ecuador northward into Colombia, and caravans are toiling through every Colombian valley with such products as these isolated people can afford to ship or buy. Against every obstacle these people struggle on and contribute such as they can to the commerce of the world. These things show that the conception of a great railroad through this region was not wholly visionary, and it is evident that Cartagena must be the natural northern terminus of such a line. From this point the distance to New York is only 2,100 miles, while the shortest distance by land would be 4,000 miles; and this journey by sea could be reduced to less than four days, if traffic should warrant it.

Such a trunk line from the Caribbean Sea into the republics of the South will probably reach its consummation slowly, and yet no man can say what the future holds in store. Under the stimulus of rapid and inexpensive transportation, progress may be as rapid here as it has been in Argentine. Certainly the Colombian and Ecuadorean is a more promising subject for training into habits of industry than was the cattle herder of the southern pampas. Moreover, American capital is going into these northern republics, and Americans will follow in goodly numbers, taking with them their proverbial thrift and energy. Swiftly or slowly, such a road is coming; and by the time the northern extension is complete, the southern will have been finished also, and the dream of an intercontinental railroad will be so far realized that one may travel in a palace car from the Caribbean Sea to Buenos Ayres.

STRAIGHTENING A LEANING CHIMNEY.*

It will, perhaps, be interesting to those having similar property, or to any who may have similar work to do, to know how a brick chimney 100 feet high, which leaned about 28 inches, was made plumb. This chimney is that of the Ormsby Textile Company, of Waterford, N. Y.

It was erected in 1893. Soon after its completion it was found to be considerably out of plumb; and when first measured, in November, was found to lean about 16 inches and a few days later 22 inches. Then the rate of increase of inclination became less, but in March, 1894, it was 28½ inches out of line, and it was decided to attempt to straighten it. The factory to which the chimney is attached stands on the north side of the north outlet of the Mohawk River, and distant, perhaps, one-third of a mile from the west bank of the Hudson. The underlying rock in this part of the country is the Hudson River shale. Where this rock comes to the surface it is very irregular in shape, and is probably equally so where it has been covered by the earth deposit. In the vicinity of this mill no rock comes to the surface over a section about three-quarters of a mile long and one-quarter wide. The earth deposit throughout this tract is apparently quite uniform in quality, yet a great variation in it is possible. Since it is probably all a river deposit, one spot may be good earth or sand or gravel while another may be largely vegetable matter and much softer.

In giving an account of this work I only act as a recorder of facts which were given to me by Mr. Ormsby. I was not at home when most of the work was under way, though I witnessed a portion of it.

The chimney proper is rectangular in plan, is built of brick, is 9 feet 6 inches square at the bottom and 5 feet 4 inches square at the top; it is 100 feet high and has a central flue 3 feet square. The estimated weight of this is 206 tons. It stands upon a foundation which is 14 feet deep, the lower 4 feet being of concrete about 14 feet square, on which rests heavy stone work 10 feet high, 14 feet square at the bottom and 9 feet 6 inches square at the top. The weight of the foundation is about 149 tons, making a total of 355 tons resting on 196 square feet, about 1·8 tons per square foot.

Before commencing the work, soundings were made on all sides of the proposed site. These varied from 20 to 38 feet in depth below the natural surface of the ground, and indicated the same character of soil as its surface, a soft, alluvial deposit, with streaks of sand,

* Paper read by Joseph C. Platt, Waterford, N. Y., before the New York Meeting (December, 1894) of the American Society of Mechanical Engineers.

but with no hard material or rock or bowlders. The chimney was built upon this soil without the use of any piles. Two similar chimneys had been built in the immediate vicinity on what appeared to be similar material, and no trouble had been experienced with these. The bottom of the concrete is about 2 feet above normal summer level of the Mohawk River, but at the time of sounding in March it was submerged about 4 feet, it being found that the water rises and falls in the soil in the vicinity with the rise and fall of the river.

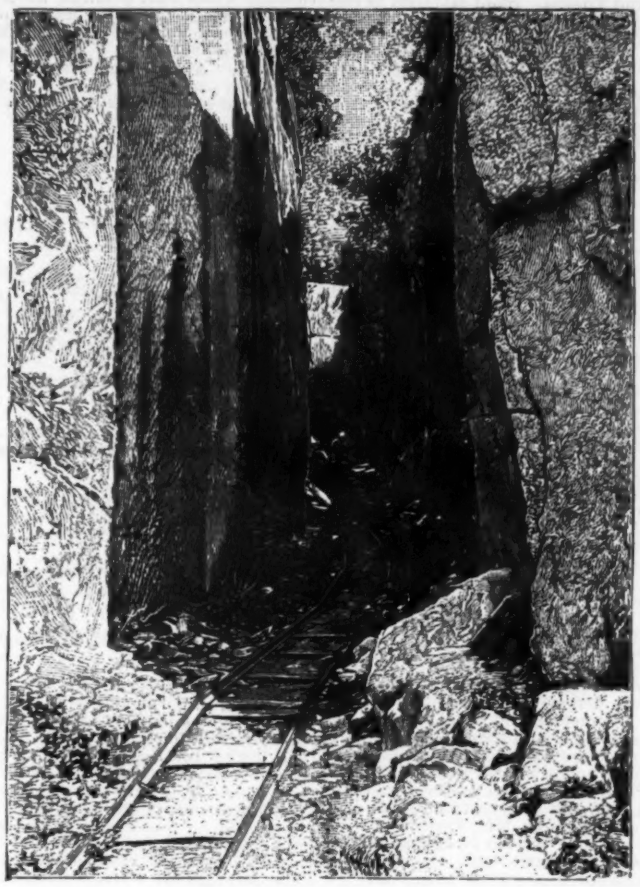
The work of straightening the chimney commenced on March 19, 1894. A scaffold was erected about the chimney, and eight oak timbers 6 inches by 10 inches by 10 feet were placed vertically at the corners at a height of 42 feet above the stone work and 4½ feet below the center of gravity of the brick work, the object of the oak timbers being to spread the bearing of the wire ropes over as large a section as practicable.

Wire ropes were passed around the timbers, and another wire rope 2½ inches in diameter, with an eye in each end, was fastened to the first mentioned ropes at its upper eye. The lower eye was connected with a system of pulleys secured to the dock at the river edge at a point 78 feet distant and directly opposite the direction in which the chimney leaned, the pulleys being made up of three sets of double and single blocks connected together in series, having three points of fastening to the dock and having 11 pulleys in the system. Cables were also put out from the chimney on each side at right angles to the main cable, and having turn buckles to tighten them; also a guard cable in rear.

The earth was then excavated on the high side of the foundation, nearly half way around to the bottom of the foundation (a depth of 13 feet), and the main cable put under strain with the pulleys. By this means, in the course of three weeks, the chimney was brought back about four inches. Then with a post hole digger, 8 inches in diameter, 11 holes were sunk vertically in the bottom of the trench around the foundation, principally at the highest point, to a depth of 5½ to 6 feet. At this time the water in the river stood up to within 1½ feet of the bottom of the foundation, the ground being soft to a depth of four feet; it then became very hard, showing that the strata supporting the chimney had been reached. No movement or flow of the soil was discovered until the eighth hole was sunk 4½ feet and the tool withdrawn for clearance, when it could only be reinserted readily about 3 feet, and headway made very slowly. From this removal of the earth there resulted, within a few hours, a righting of the chimney to the extent of 5 inches. This increased to 8 inches by the next morning. The slack of the pulling rope was taken up as fast as the chimney moved, and the rope was kept under strain. By tightening up the pulley rope two or three times daily in a week the chimney was brought back to 8¾ inches.

At this point, in similar manner the post hole diggers being reduced to 6 inches in diameter, about one-fifth as much more material was removed, immediately followed by righting the chimney to 4 inches, and from that point after filling the holes with fine broken stone and gravel, thoroughly rammed, by continued daily strain on the main cable, the chimney was brought back to plumb at the rate of a quarter of an inch per day. The turn buckles in the side cables were occasionally used to control any tendency toward lateral inclination.

The work has been accomplished without injury to the structure. Time alone can tell whether it will permanently retain its position. It is stated that some chimneys at Louisville, Ky., which were straightened in a similar manner, have remained in proper position. This chimney settled in all 0·598 of a foot.



REMAINS OF THE ANCIENT ROMAN CANAL.

THE WATER SUPPLY OF SAINT-RAPHAEL AND FREJUS.

THE city of Frejus and the town of Saint-Raphael are both situated in the Department of Var, France. Frejus is on the sea coast and is on the line of the rail-

RUINS OF THE ANCIENT ROMAN AQUEDUCT AT FREJUS.

way between Nice and Toulon. Saint-Raphael is one and one-half miles distant to the southeast. Although Frejus contains only 2,791 inhabitants it was considered necessary to supply it with plenty of water free from all contamination. This only necessitated a reconstruction of an important work of the Romans, which was sufficient to supply a city of 100,000 inhabitants. In Roman times Frejus or Forum Julii, as it was named, was the most important and flourishing port of Gaul. This accounts for the imposing ruins of walls and aqueducts which remain. Frejus still preserves the main lines of an aqueduct constructed by Julius Cæsar or Augustus, historians being not quite agreed on this point. A comparison of this grand work with our modern canals will easily prove that a vast number of workmen would be necessary to accomplish such a result without the aid of the modern machinery which we consider so essential in all engineering works. In constructing the canals and aqueducts to supply the city and the militia, the Romans followed a course from the river Siagnole to the city, a distance of 50 kilometers (31 miles), a course so direct and so logical that modern engineers have adopted it, and they could not have made a better choice. Siphons, of course, replace the aqueducts. At every step the laborers found curious traces of the ancients. In the live rock they found the marks of the iron pick, stumps of props and, above all, a series of arcades admirably preserved on which the ancient aqueduct rested.

The new canal brings the waters of the Siagnole, which rise at the base of the foothills of the Alps, to the city. The captive waters are carefully isolated from all contamination and infiltration. The canal is vaulted the entire distance. For 12 kilometers the old Roman canal is used. In parts where it was injured it was repaired. After this 12 kilometers the canal arrives at the summit of a hill, on which the picturesque village of Callian is situated. From this point it traverses the valley by a siphon 4 kilometers long. From this point on the water is conducted by a series of tunnels and siphons by way of the Esterel Mountains, until, after a total distance of 54 kilometers, the canal ends on the last summit of the Esterel Mountains, near the sea, from whence the waters are conducted to Frejus and Saint-Raphael, where monumental fountains were erected in honor of the work, which has been executed in little less than a year, by two distinguished engineers of the Ponts et Chaussees, MM. Perrier and Rebuffel. For our engravings and the foregoing particulars we are indebted to L'Illustration.

EIGHT HORSE POWER OIL ENGINE.

ONE of the few novelties in the Smithfield Club show is the oil engine exhibited by Messrs. Howard, of Bedford. It is a well finished eight brake horse power oil engine, the mechanical details of which are very simple. Like all others, it works on what is known as the Otto cycle. It is of the type which is included in classes 4 and 6 of our classification of these engines, namely, one which receives and converts the oil into a gaseous vapor in a vaporizer separately heated by an oil lamp with forced air combustion; and in which ignition is effected by an ignition tube, heated by an oil lamp with forced air combustion.

The oil is injected into a heated vaporizer, where it is met by a current of heated air and vaporized before it enters the cylinder, there to be mixed with the proper volume of air to form the combustible charge, which, when compressed by the return stroke of the piston, is fired by the ordinary ignition tube. A screw adjustment, varying the stroke given to the pump plunger, determines the quantity of oil for each explosion in the cylinder, the oil being admitted by an oil regulator, which is controlled by the hit-and-miss finger of the Holt governor. The arrangement and form of the vaporizer are shown by the engravings, Figs. 1 and 2, herewith, the vaporizer being shown partly in section from a rough sketch. In this A is the back end of the cylinder, to which an inclined casting, B, is fixed. In the casting, section of which on the line, N N, is given in Fig. 2, there are two long round passages, and at the lower part is a flat passage, G, this passage being the final gasifying chamber. Oil enters at D through a fine hole, through which it is injected under a small pressure into and hits the lower surface of the passage, E. A small quantity of air is admitted by the valve, V, into the passage, F, where it is heated. At the upper end of the passage, F, it enters the passage, E, where it is further heated and comes into contact with the oil jet from the pipe, D.

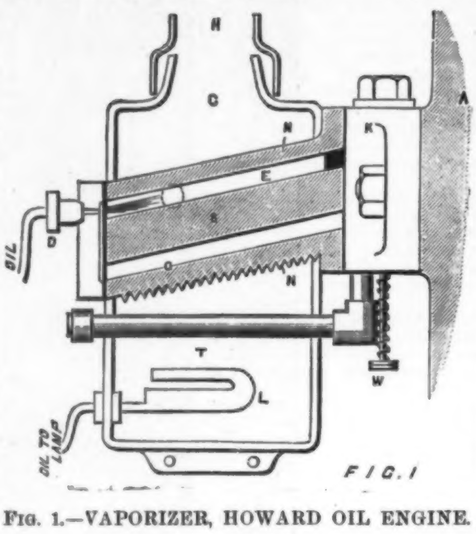


FIG. 1.—VAPORIZER, HOWARD OIL ENGINE.

By a connecting port at the lower end of the passage, E, the air vapor passes into the hottest passage, G, where the vapor is converted into a gas and passes into the working cylinder, when permitted to do so by the lifting of the valve, W. The vaporizer is surrounded by an asbestos lined case, C, surmounted by a chimney, H, and below the vaporizer is a lamp, L, which heats the ignition tube, T, as well as the vaporizer. The bottom surface of the latter has cast upon it a number of pointed projections, which increase the heat receptivity of the bottom part of the chamber, C. The passage, G, when it enters the valve case, K, is

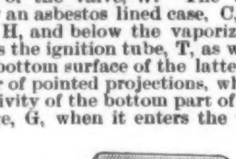


FIG. 2.—SECTION N N.

directed so that it passes over the valve, and the ignition tube, T, enters a separate port open to the cylinder.—The Engineer.

EMERY WHEELS.

By W. SAMUEL WORSSAM, C.E.

PROBABLY no tool has developed more rapidly or attained greater prominence in the department of arts and manufactures than the emery wheel or disk for grinding and abrasive purposes.

Some thirty years since, such a tool was comparatively unknown. Compositions of certain materials in a solidified state, in the form of wheels, had unquestionably been employed for various grinding and abrasive purposes, but with a comparatively limited application by reason of their inferior quality. The amalgamating agents being in most cases glue and treacle, were not proof against the decomposing effects of any unctuous matter that came in contact with the wheel while working. An American (C. Goodyear) subsequently hit on a better system of concretion by making the medium of consolidation India rubber or gutta percha. While of a plastic or doughy consistency, any formation could be given to this substance, after which it underwent certain processes of induration by heat to give it the requisite hardness. The chief defect of this vulcanite, or ebonite as it was termed by the inventor, lay in the fact that the matter forming the grit, being of a tough, horny character, and not very friable, instead of disintegrating in the act of cutting, softened under the friction. The result of this was the glazing of the cutting edge of the wheels, with a proportionate lessening of its powers of attrition, which could only be partially restored by applying red hot iron to the deteriorated parts.

Matters remained in this state until 1862, when among other important inventions brought to light at the London International Exhibition of that year was one which engaged a good deal of attention. This was a compound of oxidized linseed oil, sulphur, and some gritty material, preferably corundum or emery, and termed by the exhibitors "consolidated emery."

Corundum is the earth alumina found in a crystalline state. It is octahedral, rhomboidal, or prismatic. In hardness it is next to the diamond. The amethyst, ruby, topaz, and sapphire are considered as varieties of this mineral, differing from one another chiefly in color.

It is found in India and China, and is most usually in the form of a six-sided prism or pyramid. It is nearly pure anhydrous alumina (Al_2O_3), and its specific gravity is about four times that of water. Its color is various, green, blue, or red inclining to gray, due to traces of iron, copper, etc.

Emery is an amphorous variety of corundum and sapphire, found concrete or fairly granular, its color varying from a deep gray to a bluish or blackish gray, sometimes brownish. Its constituents are alumina 80, oxide of iron 10, silica 6, lime 2. The emery of commerce comes chiefly from the Isle of Naxos, in the Ægean Sea.

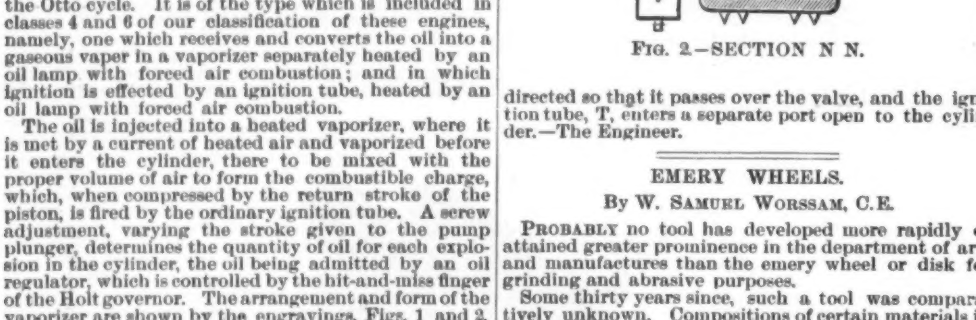
As previously remarked, one of the chief difficulties with the earlier wheels was the glazing of the surface. This was obviated almost completely in the new wheels by the invention of Jacques & Fanshawe, chemists, who succeeded in adapting a peculiar material discovered by F. Walton (of Lincrusta Walton fame) as a substitute for the India rubber or gutta percha heretofore used as the concreting agent, and for the grit they employed emery or corundum. The base of the binding material referred to was boiled linseed oil, which, being spread in a thin layer on wood or metal, was exposed to heat. This caused a revulsion to take place in its elementary constitution, the fluid being converted into a semi-dry body by the absorption of oxygen and the disengagement of carbonic acid. On the addition of gummy or mucilaginous matter, such as shellac, asphalt or bitumen, a thick paste was formed, which, after being kneaded and worked between powerful rollers, formed the composition for binding the gritty cutting substances, such as corundum, emery, steel or iron filings, glass, etc., together. One of the advantages this substance had over vulcanite or ebonite was its indifference to changes of temperature, thus rendering it suitable for service in hot climates. It was also unaffected by oil or grease, whereas India rubber or gutta percha is readily destroyed by these unguents. The discoverers of this remarkable body were not long in availing themselves of its characteristics, in the manufacture of wheels or disks for cutting and grinding.

In 1862 they (Jacques & Fanshawe, since L. Sterne & Co.) obtained a patent for "Improvements in the Manufacture of Grinding and Polishing Tools and Surfaces," and, after a number of experiments and crucial tests, succeeded in producing wheels and disks which have subsequently proved so invaluable.

The procedure adopted in the manufacture of these consolidated emery wheels may thus be briefly described. Camplicon or oxidized linseed oil is mixed with about half its weight or other suitable proportion of shellac, asphalt or bitumen, so as to produce a thick paste or dough that may serve as a good agglomerating medium for binding the emery, corundum, pulverized glass, fine granulated iron, or iron and steel filings or borings, or other hard cutting and gritty material, reduced to a finely divided condition, together in one homogeneous bulk. To this must be added 10 per cent. of powdered sulphur when iron for steel filings form no portion of the composition, but when these constituents are employed, sulphur must be omitted. Care should be exercised that all the component elements be well assimilated, and incorporated for homogeneity. The mass is then submitted to about 350 degrees of heat in an oven with a dry heat, or an atmosphere of steam of the requisite temperature, in order to harden and solidify it. As anterior to the baking or heating process the compound is soft and plastic, it may be moulded into wheels or disks of any form or shape, suitable to the configuration of the work for which they may be required. The nature of this "consolidated emery" is such that it may not alone be employed for grinding or cutting metals, but also for glass, flint, slate, marble, and similar substances. It can be used dry or with water. Dry, if the material to be operated on can withstand the friction, with water where heating would be injurious. Many other kinds of wheels and disks have been introduced within recent years, such as the Tanite, Norton, Bateman, Luke & Spencer, Diamond, Sterling, Sundale, Naxos, Detroit, Celluloid, etc., but the original wheels of Jacques & Fanshawe and called the "Sterne"—the name of the maker—will hold their ground. They are, particularly when thin, more reliable, and do not split and fly when running at the high speed necessary to obtain the best results, as happens in the case of some others.

The emery wheel, as an adjunct to every workshop where grinding has to be done and machine tools are used, is now considered indispensable, and its usefulness and economy are yearly becoming better understood and appreciated; it has not been inaptly described as "a rotary file whose cutting points never grow dull."

To such perfection has the manufacture of these wheels reached, that they are made in sizes varying from $\frac{1}{16}$ in. to 8 in. in thickness and from $\frac{3}{8}$ in. to 40



EIGHT HORSE POWER OIL ENGINE.

in. in diameter. Their economy in working is marvelous; a man can drive a file about 60 ft. a minute over a flat metallic surface, but it is soon worn out, whereas a well made emery wheel will work up a surface of 5,000 ft., and last a considerable time without appreciable wear. It has been proved repeatedly by practical men, after careful experiments and observation, that to remove a pound weight of iron with a file costs about 2s. 6d., while the same amount of work can be done by a good wheel at the moderate expenditure of 4d.; and, further, the latter will execute the work in about one-eighth less time than the file. An emery wheel will frequently cut away twelve times its own weight in metal before becoming useless. As an instance of the great cutting power of consolidated emery may be mentioned the fact, that a disk, 12 in. in diameter and only $\frac{1}{16}$ in. thick, will cut slits 4 in. long in tough cast steel $\frac{1}{2}$ in. thick.

The "Sterne" wheel is made in four distinct classes, entirely different in composition and method of manufacture, each class being made of ten gradations of quality, from very coarse to superfine, to suit for heavy work or the light grinding of fine metal work, knives, and other instruments and purposes.

1. The consolidated emery wheels are made in sizes from $\frac{1}{16}$ in. to 6 in. thick, and from $\frac{3}{4}$ in. to 36 in. diameter. A special feature of these wheels is that they can be run either dry or with water, making them very suitable for all kinds of tool grinding and sharpening. They are invaluable for saws, fettling, and trimming castings.

2. The amalgamated emery wheels are specially adapted to grinding brass, copper, and other soft metals and alloys.

3. Composition burr emery wheels are specially suited for decorticating and grinding rice and other grain, and are found superior and more economic than the French burr stones, which they are generally superseding.

4. Compound emery wheels are available for many particular operations, and for dry grinding of hot or chilled cast iron rolls. It is difficult to enumerate the varieties of work for which these wheels, in their different grades, are available; there is a constantly increasing demand for them, and not only have they become a necessity when once adopted, but new fields of application are daily opening to them.

They are of the greatest service for all kinds of engineer's tool grinding, saw sharpening, fettling and trimming castings, grinding chilled rolls, locomotive slot links, plane irons, knives, India rubber rolls for wringing, printing, and other machines, bushes, eyes, female mandrels, straight and spiral reamers, milling cutters, taps, circular knives and slitters, lathe centers, twist drills, etc.

For polishing this type of wheel is unsuited, as even with superfine grit, they will cut or grind. For this operation it is necessary to first grind the article to a perfectly flat surface with an emery wheel and subsequently to make use of a buff wheel or glazier—a wooden wheel having a leather periphery coated with a mixture of the finest washed emery powder and thin glue, spread on as evenly as possible; after the first coat of the mixture is dry, a second and third may be added. When this composition has worn away, the rim should be washed with warm water, and when dry, the covering process may be repeated. The finishing polish is best obtained by daubing the leather rim with rouge composition and oil. Some buff wheels have a ring of metal consisting of an alloy of lead and tin instead of the leather; in this case loose powdered emery is used, after the manner of an ordinary lead lap or grinder.

With regard to the treatment of the emery wheel in work, this, when worn oval or out of circular shape, must be trued up or redressed in situ by a diamond tool or other suitable appliance, which gradually effaces all protuberances and irregularities, and again brings the cutting edge to the general circumference; or it may be removed from the machine and turned true in a lathe, or filed or chipped. At one time a heated iron was used for this purpose, but this method is unsatisfactory, and obsolete in any workshop claiming to be modern and up to date. The hot iron glazes or greases the composition, and the wheel will consequently not "bite" the material, until it has been several times used; whatever mode is used, the wheel must be true, for if out of balance, it loses greatly both in serviceableness and safety. Undoubtedly the best plan for redressing is by means of the diamond tool. This consists of a Brazilian black carbon or diamond, weighing about one carat, inserted in one end of a suitable holder, usually carried by a slide rest, having compound movements, like that of an ordinary lathe for metal, and constructed to be bolted to the standard of the machine carrying the wheel, which should be reduced in speed from 4,000 to 6,000 feet to 60 to 80 feet per minute; although the diamond can be used at the ordinary running speed, if care be exercised and a very light cut taken. The diamond should be fed slowly to the work to prevent shock; the harder the diamond, the more brittle it is, and anything like shock must be guarded against. A deeper cut of more than $\frac{1}{64}$ inch should not be attempted. The diamond only must touch the wheel, otherwise the setting will be ground away, and allow the carbon to fall out of the holder.

In the States a diamond tool is in vogue which can be wielded like a lathe hand turning tool, such as a graver or heel tool, with a long haft. There is likewise an instrument called the Huntingdon dresser, which consists of a lever having at one end instead of a diamond a small serrated steel wheel or rowel, which, on being pressed against the edge of the rotating emery wheel, revolves by the contact and hacks away the projecting grains of emery, leaving the wheel in good cutting order.

By the employment of the diamond tool, the periphery of the wheel can be turned to almost endless varieties of shapes—round, concave, beveled, pointed, etc., as are required. The wheels usually leave the moulds square-edged, and are afterward turned to the necessary shape in the manner explained. Still, they can be moulded into any form in the course of manufacture as decided on beforehand.

The peripheral velocity of these wheels is from 4,000 to 6,000 angular feet per minute. The wheel, before being mounted on its spindle, should, if thin, be examined, to see that it is perfectly flat, and the outer crust removed. Care must be taken that it does not fit too tightly on the mandrel, or it will be liable to crack when running. Wooden collar, India rubber, or one or more thicknesses of paper well soaked in water, should be inserted between the wheel and the iron flanges or washers which retain it in place, and these must not be too tightly screwed up. Neglect of these precautions is oftener a source of fracture than any inherent defect in the wheel itself.

Not the least call on these wheels is that for sharpening machine saws. A well made and mounted emery disk, properly worked and running from six to nine hours a day, will last some three months, and will gullet, sharpen and top on the average 200 deal frame saws each day of nine hours. It is found in practice that the action of the disk on the teeth hardens the cutting points, with the result that the saws last longer when machine than when hand sharpened.

No saw mill can be reckoned fully equipped which is without a saw-sharpening machine; it pays even when there is only one frame or saw bench. A great economy is effected in labor and files; a man at the machine will do as much work as six sharpeners by hand simply. In respect of the cost of files, it may be said that this is almost entirely saved, each disk costing but a few shillings, and lasting in constant work for several months. Some workmen are so skilled in the use of the machine as to be able to turn out the saws topped ready for working. Another great merit of the machine is that the tooth spaces or throats can easily be maintained at a uniform depth, whereby the saw not alone works better and quicker, but less power is required to drive it, and the risk of buckling in regulieting or toothing, which is needful when the teeth are allowed to become stunted or stumpy, is absent.

In concluding this article I cannot refrain from observing that in the discovery or invention of "consolidated emery" we have a striking illustration of the beneficent and far-reaching results which sometimes spring from small causes. The inventors, in all probability, never for one moment anticipated the great diversity of uses to which their invention would ultimately become applicable.—Industries.

THE FRIEDEBERG APPARATUS FOR BURNING COAL DUST.

MR. FRIEDEBERG, of Berlin, has devised for the burning of coal dust an apparatus which is exploited by the Allgemeine Kohlenstaubfeuerung Actiengesellschaft, and the arrangement of which is shown in the accompanying figure.

The idea of introducing coal dust into furnaces through an insufflation of air is not new. For the burning of coal in powder derived from the residua of bins, Mr. Corbin, years ago, conceived the idea of sending it into a hopper at the base of which there was a charger provided with a wide cavity. At every revolution of this charger, its cavity became filled with coal dust, which it emptied into a conduit, whence the dust was forced by a blast of air into the flames of a coal furnace.

In certain applications also the coal has been pulverized by crushing cylinders that discharged it upon the vanes of a blower, whence it was thrown into the flames of a furnace.

The general features of the Friedeberg process are likewise found again in the Molinos and Prounier furnace. Finally, Messrs. Baumert and Wegmer have very recently made some interesting tentatives with a view to the heating of boilers by powdered coal.

Mr. Friedeberg has resumed the study of the arrangements to be employed for feeding the furnaces of manufactories, and the apparatus that he has devised to this effect is as follows.

The vertical tube, a, for introducing the air serves as a pivot to the system, which comprises: 1, the movable jacket, b, to which are bolted the primary air conduit, c, and the secondary air conduit, d; 2, the hopper, e, supported by the chest, f; the inlet pipe, g, and, finally, the conical chamber, h. The chest, f, is supported by the conduit, d, but is not in communication with it. The fixed pipe, a, is provided at the side with two apertures in front of which the two conduits, c and d, coincide when the apparatus is in operation. At a stoppage, a rotary motion is given the system and the apertures of the pipe, d, are closed by the sides of the movable jacket.

The conduit, c, is divided into two branches which enter the chest, f, through tuyeres so arranged that the blast of air sets the dust in motion and carries it through the square passages, i, into the inlet pipe, g. All the fine coal that may chance to be in the dust falls to the bottom of the pipe, g, whence it may be removed through the maneuver of a slide valve.

The large horizontal pipe, d, ends at a vertical conduit which, through a tuyere, debouches in the conical chamber, h. The conduits, c and d, are provided with valves that serve to regulate the discharge of the air blown in.

During the running, the mixture of air and coal dust that enters the conical chamber through i and g meets a current of air therein that has been led by the pipe, d. It is then thoroughly mixed and carried in the direction of the furnace, as shown by the arrows.

In default of precise results derived from official trials, we give the renderings obtained in some particular experiments, although these present some anomalies that are difficult to explain.

FIG. 2.—APPLICATION TO A CRUCIBLE FURNACE.

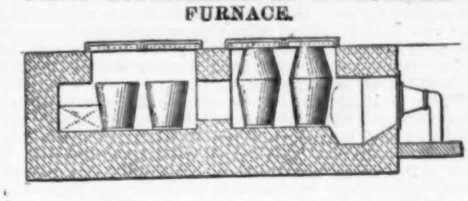


Fig. 3.

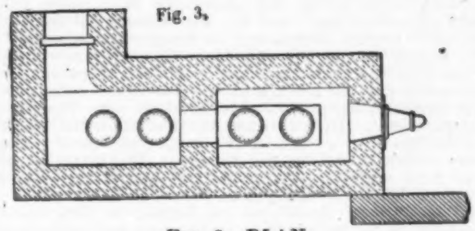


FIG. 3.—PLAN.

The ventilator absorbs from $\frac{1}{2}$ to $1\frac{1}{4}$ horse power, according to the dimensions of the apparatus and the quantity of coal dust to be introduced into the furnace. For burning 10 pounds of dust it would require but from 10 to 15 pounds of air. The supplementary expenses occasioned by the use of a blower would therefore not be very heavy and would be covered by the perfect combustion attained with this process of heating. Such combustion would be so regular and so complete that the sides of the fire box might be raised to a white heat in a very short time.

Up to the present, this apparatus has been constructed according to two types only, one of them capable of blowing from 10 to 100 pounds of coal dust into a furnace per hour and the other from 20 to 330 pounds. The arrangements taken permit of exactly regulating the introduction of the fuel. The emission of the dust is regulated by the pressure of the air and no smoke is produced. The fineness of the dust employed depends upon the nature of the coal. It is possible to employ sieves with 0·25 mm. meshes, but the best results are obtained with 0·1 mm. meshes. It is possible also to charge the blown-in air with a certain quantity of humidity, according to the nature of the fuel employed.

One of the first applications of this process has been made, in the establishment of Messrs. Arndt Brothers, at Berlin, to a 16 horse power tubular boiler operating at 16 lb. The steam is furnished to a 12 horse power engine which does not give its full power. The consumption of dust per 12 hours of work is, on an average, 715 pounds, which corresponds to 4.950 pounds of fuel per horse and per hour, inclusive of the coal employed for putting the boiler under pressure. This apparatus has been operating with success since the beginning of the present year.

Two apparatus of the largest size have more recently been applied to a two furnace boiler in the glass works of Messrs. Ebert and Neumann, at Stralau, near Berlin.

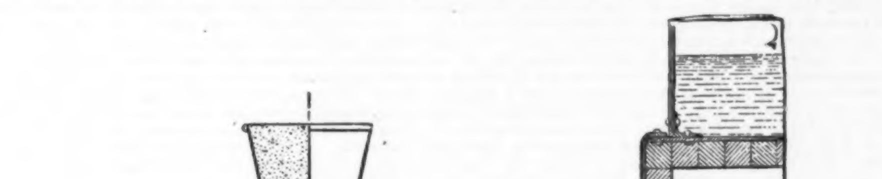


FIG. 1.—FRIEDEBERG APPARATUS FOR BURNING COAL DUST.

This boiler, which vaporizes at 16 lb., has a heating surface of 980 square feet. The steam is furnished to a 50 horse power engine. In this establishment fine broken English coal is used. Before the application of the process, the daily consumption of fuel of good quality was 6,900 lb., but it has now fallen to 5,580 lb.

In order to permit of an estimate of the value of the system from the results of these two experiments, it would require some concordance between them. It is not explained that the less powerful engine consumes but 4,950 lb. per horse hour, while the more powerful one consumes 9,350. On another hand, it is estimated that the weight of air necessary for the combustion of 10 lb. of coal dust is but from 10 to 15 lb. Now, according to the elementary composition of good anthracite, it requires, theoretically, 24 lb. of air for completely burning 2¼ lb. of it, and we know that, ordinarily, the volume of inflowing air notably exceeds that which is necessary for the combustion, and sometimes reaches double the volume. In the case under consideration, the results announced correspond, as to consumption of air, to scarcely a tenth of the theoretical figure. It is therefore necessary to suppose that the dust of which it is a question is rich in ashes and poor in combustible matter; but the output of fuel per horse hour should then greatly feel the effects of its feeble calorific power.

While waiting until we shall be more exactly decided as to the value of the Friedeberg apparatus applied to steam boilers, it is well to make known a tentative made toward the use of it in foundries with a view to the substitution of coal dust for the expensive metallurgic coke. In fact, a special furnace has been constructed to which the apparatus in question has been adapted (Figs. 2 and 3). The interior of the furnace is 10 feet in length and its height corresponds to the dimensions of the crucibles. The furnace is divided into two parts, the front one of which serves for the melting of the metal and the back one for heating the crucibles before introducing them into the first compartment. In a furnace of this kind, 110 lb. of copper has been melted in 45 minutes, inclusive of the time requisite to heat the furnace. The quantity of coal dust employed per pound of metal melted is 6 ounces. With the old system, from 2 to 4½ lb. of coke were employed. Apertures are formed in the top of the furnace to permit of the removing and replacing of the crucibles without arresting the heating. The loss of heat during these operations is very slight, and the work is thus carried on with much rapidity, and so much the more so in that the preliminary heating of the crucibles is a great help.

Admitting, even, that we must employ as much coal dust as coke, there would still be a gain of 50 per cent., on account of the difference in the price of the fuels (at least this is what is claimed in Germany), and, since the consumption of coal dust corresponds to but a third of the weight of metallurgic coke, necessary with the old system, the saving claimed would be still greater. Besides, the Friedeberg apparatus presents the further advantage of prolonging the life of the crucibles, which are no longer in direct contact with the coke. It renders the work cleaner and permits of reaching much higher temperatures.—Revue Industrielle.

IMPROVED METHODS OF HOUSE DRAINAGE.*

MR. PRESIDENT AND GENTLEMEN OF THE ARCHITECTURAL LEAGUE:

Your committee has honored me with an invitation to prepare a paper for this meeting and has left me entirely free to select some topic from the wide and constantly growing field of sanitary engineering. The sanitation of houses, school hygiene, hospital construction, rain baths, domestic gas lighting, the sanitary features of the laying out of cities, water supply, fire prevention and fire extinction, the safety in theaters and halls of amusement; these were some of the numerous subjects which occurred to me as being of interest to the members of the Architectural League.

After thinking the matter over for some time, I concluded that it would be better to select a subject in which I have been most actively engaged in the past years. Accordingly, I decided to speak to you on "Improved Methods of House Drainage," although I was well aware of the fact that I could not attempt to treat the matter from any novel point of view, for, while the subject is of paramount importance, and one in which every architect takes an interest, it has been quite frequently discussed, and there are numerous books, pamphlets, essays and lectures which go into the matter very fully.

I can, therefore, assure you that it is with the utmost diffidence that I come before to-night to give a brief address on what many of you will doubtless consider a dry and uninteresting subject.

My endeavor will be to explain some important improvements which have been brought about in the past ten years in the art of draining houses.

To begin with, one quite noticeable improvement relates to drainage plans. Until a comparatively recent period of time, it was an exception to find elaborate plans and sections of the plumbing and drainage system of buildings. The location of the plumbing fixtures was, to be sure, indicated on the floor plans of the building. Beyond this very little information was given. It was not usual to mark the number and sizes of soil pipe stacks, neither was the run and course of the drains indicated on the plans. I believe I am not mistaken in stating that in architects' offices the practice of making a special drainage plan began with the enactment of the plumbing laws. At least, I remember distinctly that when, as chief engineer of a house drainage company, it was my privilage, about ten years ago, to estimate in some of the prominent architectural offices in this and in other cities, I was given plans to estimate on where the drains and soil pipes were neither shown nor enumerated nor described in the specifications. All this has undergone a great change in the past few years.

Owners of buildings are much benefited by the plumbing laws, which require plumbing plans to be filed in the city health or building departments. Even where in the actual construction of the work the drainage plan is more or less modified, there is kept on record a usually tolerably accurate plan, showing the position of pipes, in case of future reference. In important cases, a revised drainage plan is subsequently made, showing the work as actually put in.

The contractors are benefited by it, because they know better on what work and what quantities to base their estimate.

Their workmen on the building are, likewise, benefited, because they can find, by referring to the plans, where the pipes are intended to be run. The architects and the building superintendents are benefited, because they do not have to answer so many questions to the foreman in charge of the plumbing and drainage, and because their time is not so much taken up at the buildings in course of construction with the laying out of the sometimes complicated work. The many advantages resulting from well considered drainage plans become particularly apparent in the case of large and important structures, such as hotels, hospitals and modern office buildings.

Another improvement relates to plumbing and drainage specifications. While formerly plumbing specifications were somewhat indefinite and too general in character, with the inevitable result that estimates for the work ran widely apart, it is now universally recognized that plumbing is a question of vital importance in building construction, and much more care is exhibited in the preparation of the specification. Other things being equal, it is self-evident that the more thoroughly detailed and accurate the specifications are—which does not necessarily mean elaborate—the closer will the bids for the work run, and the more will the finished work conform to the expectations of the architect or his client. In this connection, permit me to state that the too general use of the printed blank plumbing specifications of the building department for contract work is not, in my judgment, to be approved. Such blank forms may be exceedingly convenient and labor saving for the inspectors of the department, but for all except the smallest houses or tenement buildings, or simple warehouses, they are not sufficiently detailed. A contract for a large job should be based on a separate typewritten or printed specification. Too much care cannot be bestowed upon the specification. It is my experience, and doubtless it is yours, that the number of extras in the final plumbing bills is inversely in proportion to the completeness of the specification. I refer here, of course, only to the extras which the architect finds himself compelled to order owing to omissions in the original specifications, and I do not include those sometimes quite numerous extras which owners or building committees require.

Now let me turn to the question of materials. Here, too, we cannot fail to find numerous and important improvements. Formerly the house drain inside the building consisted of earthenware pipes. The soil pipes were run of lead pipe, with hand-made seams. You are, I trust, sufficiently aware of the objections to such materials. Happily they have gone out of use. The first improvement consisted in using iron pipes for drains and soil pipes. For many years it was customary to use the so-called light or standard plumber's soil pipe. When the testing of drains by the water test began, the objections to these pipes at once became apparent, it being a difficult matter to calk joints in light pipes so as to be permanently air and water tight. Hence it came about that, at least in the case of the better class of buildings, extra heavy cast iron pipes were specified. From this time dates the curious practice, which I have often met, of specifying heavy pipe for the main drain, and light pipes for the vertical soil and waste pipe lines. Still later, when the practice of "back-airing" traps began, we find heavy pipes specified for both the drain and the soil pipe system, whereas light pipes were considered sufficiently good for vertical lines of vent pipes. A chain is not stronger than its weakest link, and I know you will agree with me that it was a mistake to use two grades of pipe for the soil, drain and vent pipe system of a building. As is well known, the use of extra heavy pipes is now in this city compulsory in all classes of buildings, from the cheapest tenement house to the finest private mansion. It is, perhaps, well that the rule is compulsory, for otherwise we should find unscrupulous plumbing contractors and speculative builders still making use of what they must know is an unsatisfactory material for drainage. Cast iron pipe, even of the heaviest and best quality, is apt to have sand holes or imperfect seams, hence by far the greatest security lies in ordering from the manufacturers pipes and fittings which have been tested at the foundry by hydrostatic pressure.

The most recent improvement, as regards this point, consists in the more extensive application of screw jointed, wrought iron pipe for drainage purposes, particularly in the case of high buildings. Having been to some extent personally connected with the introduction of this system in the Eastern States, I cannot help remarking that a wonderful change in opinion has taken place, in architects' offices, and to a certain extent also in plumbers' shops, regarding the merits of wrought iron pipe, and the use of screw joints in place of lead calked joints, for purposes of drainage. It is scarcely ten years ago when it was my privilege as engineer of a now defunct house drainage company to discuss with architects the advantages incident to the new method of drainage. A few architects went on record as in favor of the screw joint construction. The majority, however, guided in many cases by the advice of the plumbers, estimating in their offices, were opposed to the use of wrought iron for drain, soil and vent pipes. The pipes which were used then by the advocates of the screw jointed wrought iron system were without exception protected against rust, either by a thorough application of coal tar or by dipping the pipes, while heated, into a bath of hot asphalt, or else the pipes and fittings were made rustless by the Bower-Barff process, or finally, galvanized pipes were used, particularly for vent lines. You will readily understand my surprise to find at the present time buildings in which plain wrought iron pipes are used for purposes of house drainage, the pipes not being in any way protected against corrosion. The mistake—for a mistake it is—can be explained only by the fact that the building department requires cast iron pipe to be plain and uncoated, but wrought iron piping should, in my judgment, always have some protecting coating against rust.

Other improvements, relating to materials, consist in the more extensive use of drawn lead traps, and of brass traps, in place of cast lead traps, or of lead traps with hand made seams. I must, however, sound a note of warning against the use of certain brass traps with cast partitions, which are often found to have sand holes, and are then, of course, only a delusion and afford no protection against sewer air. The use of very light brass tubing, for exposed waste or bent pipes, should be guarded against, as also the use of light brass traps, or of traps with rough inside surfaces. Finally, the brass pipe should be of iron pipe size, i. e., full bore, and not restricted in diameter.

I pass on now to the consideration of important recent improvements regarding the sizes of pipes used for drainage purposes and the manner of laying the drains. Of the old brick drains of large size, square in shape and ill adapted to the removal of household wastes, it is not necessary for me to speak, as they belong to a former generation, although they are occasionally even now unearthed in the overhauling of older mansions. Up to within a recent period it was the custom to use for house drains round pipes which were much too large in diameter to perform their function in a proper manner. Even the smallest house had a 6 inch drain; larger buildings had 9, 10, and even 12 inch pipes. There is no advantage, and there are considerable disadvantages, in using pipes of too large bore. The old fashioned absurd ideas regarding the necessity for large pipes are now abandoned. The use of small drains is a distinctive achievement of modern sanitary drainage. It is usual at present to use a 4 inch pipe for the smaller houses. An average sized four story dwelling can be efficiently sewered by a 5 inch drain and a 6 inch sewer is sufficiently large for a mansion. Extensive buildings, such as institutions, office buildings, etc., may require a pipe of larger discharging capacity, but in that event it is preferred to use two or more drains of restricted size as being more liable to be self-cleansing.

To illustrate: The entire waste water from the plumbing fixtures in such an extensive building (vertically) as the Manhattan Life Insurance Company's building, comprising 205 wash basins, 24 sinks, [illegible] urinals, 62 water closets and including all the roof water, besides various other wastes, is successfully removed by means of two 6 inch pipe sewers, laid with a fall of ¼ inch to the foot.

The same principle applies to the soil and waste pipes of houses. Formerly 5 and 6 inch soil pipes were commonly used in private houses, and the sink waste pipe was at least 3 and often 4 inches in diameter. It is now the rule to make soil pipes of private dwellings 4 inches, and kitchen sink wastes are purposely restricted in size to 2 inches, in order to be more self-cleansing. As regards the branch wastes from fixtures, the modern tendency is to use small pipes, and not only a vast improvement, but also economy in design, is thereby effected. The traps under fixtures are likewise restricted, with the advantage that they are kept better flushed. It is under any circumstances a difficult matter to keep traps perfectly clean, but better results are undoubtedly attained where the diameter of traps is restricted, in order to concentrate the stream and thus utilize the same in scouring the channel.

One other point in connection with sizes of waste pipes is worth mentioning: I refer to the rain water or conductor pipes. The sizes of these pipes—in fact, of all vertical waste pipes—cannot be determined by mathematical rules. Whereas sizes of horizontal or graded pipes can be calculated accurately by means of hydraulic formulæ, or by tables evolved from these, I know of no rule by which to determine the diameters of leader pipes for roofs of given areas and of known pitch. I have likewise been unable to find rules derived from practical experience, or from actual tests and experiments, although I have hunted high and low for them. The only rule which I was able to find was in a recent German architectural text book, according to which publication, the diameter of a leader pipe may be determined by allowing an area of one square inch in the pipe for each 60 to 70 square feet of roof surface. I presume the smaller size is intended for roofs of a flat pitch, and the larger size for steep roofs. It is not stated for what rate of rainfall the rule is applicable. Speaking generally, heavy rainfalls are much more frequent in our climate than in Germany, so that I should advise increasing, where this rule is followed, the diameter obtained somewhat to provide for efficient roof drainage in case of very heavy sudden showers. This question of determining the size of conductor pipes is one that constantly occurs to architects and sanitary engineers, and it is to be hoped that experiments may be undertaken tending to the solution of the problem from a practical point of view.

This brings me to another question, viz.: The manner of laying drains. Whereas formerly drains were buried in the ground, and thus became entirely inaccessible, it is now much preferred to carry the main drain of a house in plain sight, above the cellar floor, either suspended from the ceiling or fastened along the cellar wall. Until quite recently, it was the rule, where the drain was unavoidably laid beneath the cellar floor, in order to drain fixtures on this level, to place the pipe in a trench formed of brick walls with concrete bottom, and covered with an iron cover. The drain was thus kept accessible in its entire length. A few architects and some engineers still favor this method of construction. In my judgment, it is more preferable, after the underground drains have been thoroughly tested and made watertight, to bed the same in the concrete, and to rely for access upon a number of suitably placed and suitably arranged cleaning handholes, made accessible by brick manholes with iron covers. Underground trenches, as usually built, are too liable to become rat runs, to accumulate dampness and dirt, and to constitute harboring places for vermin. Such inspection and cleaning handholes are very desirable in a drainage system, and they should be abundantly provided even where the pipe is carried above the floor, in order to avoid the cutting of pipes, a habit only too common with thoughtless mechanics in case of a stoppage in the pipes.

Let us now give brief consideration to a further point, in which house drainage has been greatly improved. Some years ago plans for the drainage of houses were submitted to me, in which the water closet pipes or soil pipes were kept separate and distinct from bath, lavatory and sink wastes. This double

* A paper read at the monthly meeting (Dec. 5, 1894) of the Architectural League, by Wm. Paul Gerhard, C.E., Consulting Engineer for Sanitary Works.

system, as you will readily comprehend, rendered the drainage system much more complicated and vastly more expensive without any corresponding advantage. This mistake, doubtless, arose from following too closely the prevailing English practice as described in the English textbooks on plumbing. In the absence of any practical American books on house drainage and plumbing, architects had to rely largely, ten and more years ago, on the study of English works on drainage. It is not necessary, nor even desirable, to do this nowadays, as there are available several good books on the subjects by American authors, which clearly describe the American practice. Other features of the English practice of draining houses, which are equally inapplicable here on account of differences in the climatic conditions, are the placing of the soil pipes on the outside of the house, and the running of the smaller wastes, such as bath and basin wastes, over outside gullies.

A further curious mistake which I have encountered in plumbing plans is the requirement that in case of bath rooms with water closets located vertically over each other on succeeding floors, there should be a separate line of soil pipe for the bath room of each floor, thus entailing a needless complication, a multiplication of soil pipe stacks and a greatly increased cost of the plumbing. The exactly opposite principles are followed to-day; the work is simplified as much as possible, plumbing fixtures in houses, planned by architects, are grouped together, and the drainage is concentrated, as far as practicable, in a single line of pipe, thus securing an abundantly flushed line and economy in construction.

Not very long ago, the pipes pertaining to the drainage system of a house were universally put out of sight and the fixtures concealed by expensive but useless cabinet work. Drains were placed under the cellar floor and rendered inaccessible, soil pipes were built into the walls, waste and vent pipes bedded in plastered partitions, supply pipes were run under hard wood or tiled floors. In case of accident to any of the pipes, nobody knew where to look for them, floors were torn open, the plastering cut, rich wall decorations destroyed in the efforts to reach the pipes. One of the chief features of modern work is the exposure of all pipes. Architects and owners have now become accustomed to this improvement; there are many who even fancy the new arrangement. By a clever study of the house plans, it is often feasible to carry pipes exposed, i. e., outside of walls or partitions, even on the parlor floor. I have found on this floor the main pipe lines kept accessible by a hard wood hinged pipe casing in some houses built by our most prominent architects. What a great contrast with the builders' method of the past of boxing everything up, pipes, fixtures and all!

Just a few words on the so-called open arrangement of fixtures. A decided improvement in the character of workmanship has been brought about by the improved method of keeping plumbing fixtures exposed to view. The advantages from the point of view of maintenance of cleanliness and ease of inspection are too apparent to need further discussion. I wish to dwell, however, for a moment, upon one point which seems to be less well understood. In conversation not long ago with one of our busiest architects, he remarked that the open arrangement of plumbing fixtures entailed a largely increased labor on the part of servants and therefore was not looked upon with favor by householders. This is, without doubt, true of exposed nickel plated piping. It must not be overlooked, however, that nickel plated work and exposed work are not one and the same thing. You can have one without the other. From a sanitary point of view, a job may be equally well and equally safely done if constructed of lead and afterward merely painted or bronzed. Where more elaborate or expensive work is desired, the piping may be electro-copper bronzed or finished in oxidized silver, which do not require the constant polishing which nickel finish needs to keep it bright.

Whereas in former years plumbing fixtures were scattered all over the house, necessitating a complex system of plumbing pipes, and often endangering the health of the occupants by ill contrived and defective fixtures placed in the bed rooms, the modern practice of architects, and one which cannot be too highly praised, is to confine plumbing work to the bath room, to the kitchen, pantry and laundry. The necessary fixtures are placed, as far as the house plan permits, in vertical groups, and all appliances, and the water closet and slop sinks in particular, are placed in well lighted and well ventilated apartments.

There is one mistake, however, which is still frequently committed, to which I beg permission to draw your attention. The mistake to which I allude is the placing of the water closet in the same room where the bath tub and the wash basin are located. This is objectionable on æsthetic as well as on practical grounds. It is particularly so in the case of the smaller houses, and in apartment houses, with only one bath room. In more elaborate houses of rich people, where there are several bath rooms, the separation of the water closet is not so necessary for practical reasons, but I think that a bath room with a water closet can in all cases be made much more inviting by contriving an ornamental screen, or a low partition separating the water closet from the other fixtures. The partition may be lined with marble or tiling and its upper part may be constructed of open fretwork. I have in mind several exquisitely finished bath rooms, designed by progressive architects, in which this division of the room was made a successful and greatly appreciated feature.

Much improvement is noticeable in the selection of suitable and sanitary plumbing appliances.

The objectionable pan closet is seldom encountered in modern plumbing work, plunger closets are out of date, valve closets are no longer fitted up, and improved water closet troughs have taken the place of the former privy sink. Wooden laundry tubs are no longer common, because better tubs of non-absorbent material may be obtained cheaply.

As regards the most important sanitary fixture, namely the water closet, the number of apparatus of different make and construction is legion. Practically, however, the choice lies between only a few approved types, viz., the flushing rim long hoppers, which are good, but require a large quantity of flushing water, and the improved pedestal short hoppers; the siphon and the siphon jet closets; and finally, the so-called wash-down closets, having a vigorous and direct flush. You may notice that I do not include in this list the wash-out closets, because while I do not wish to condemn them too severely, I cannot bring myself to regard them with much favor. They have several objectionable features, which do not commend them to me as a perfectly sanitary fixture. They are, notwithstanding these facts, very popular at the present time. Popularity, however, is not always a just criterion of fitness, for the same thing may be said to have been the case with the Jennings and the Zane plunger closets, with the Hellyer or valve closet, etc., all of which are now out of date.

Two points require careful attention, where porcelain water closets are used. One is the floor joints, which being on the sewer side of the water closet trap, must be made tight. The other is the connection between the piping and the earthenware horns of the bowl. If these are made rigid, breakage of the earthenware is the result of the slightest settlement of the floor. A flexible connection is therefore much to be preferred and can now be obtained with many of the types of closets named.

The limits of this paper do not permit my discussing in detail the requirements of water closets, and I must pass on to review briefly the other plumbing appliances of houses.

Speaking of wash basins, we may distinguish four principal types, viz.: 1, tip-up basins; 2, chain and plug basins; 3, open standpipe overflow basins; and 4, secret waste valve basins.

Tip-up basins are generally condemned, because in their usual form they have objectionable features. If only the receiver could be arranged so that it would not become foul, or that it was readily accessible for cleaning, this type of basin would have many merits. It is, without doubt, very convenient in use, has no concealed overflow, no chain and plug, is rapidly emptied and flushes its waste pipe and trap well at each discharge.

The objections to the second type, the common chain and plug basin, are too well known to need further comment. It is proper, however, to state that there have recently been put upon the market some modified forms of this type, which I consider great improvements upon the ordinary type. One is a siphon basin, which empties rapidly and flushes its overflow at each discharge. The overflow channel is so shaped that when the plug is inserted in the bottom of the bowl and the same filled with water, the overflow is trapped. In office buildings and in hotels, where a standpipe overflow basin or a bowl with waste valve is too expensive and too complicated for general use, the siphon form of basin has much to recommend it. The other improved form is a chain and plug bowl, in which the waste outlet has been greatly enlarged, and which has the usually hidden overflow channel made much shorter and accessible by means of a removable strainer.

The third type of basin has an open standpipe overflow, and there are numerous modifications of the device for raising the standpipe. From a sanitary point of view this type has, undoubtedly, the greatest merit of all forms, still my experience has been that the general public is hardly sufficiently educated in sanitary matters to appreciate its merits. By many this form of basin is utterly condemned on account of its odd shape and appearance. The favorite form of basin is just the one which has the most objections from the hygienic standpoint, namely, the bowl with secret waste valve. To discuss its objectionable features in detail would lead us too far.

Regarding that valuable fixture for personal cleanliness, the tub or bath tub, with its various modified forms, such as the foot tub, the sitz bath, the hip bath, the bidet, etc., I would state that tubs of wood lined with copper are less used than formerly in private houses, probably because they always require some sort of wooden casing, and also because they lose their bright appearance in use. Enameled iron tubs, standing free from the wall and raised from the floor, constitute a satisfactory sanitary fixture, which is only surpassed by the beautiful all-porcelain bath tubs. Both kinds of tubs are now obtainable with a glazed roll rim, thus doing away entirely with all wood work. I ought, perhaps, to mention in this connection that a great improvement in the manufacture of American earthenware has recently taken place, and that it is now for the first time possible to obtain porcelain bath tubs made in this country. In regard to the appliances used for holding water in the bath tub and for emptying the same, much of what I said of wash basins applies here. In this matter I may appear to you old-fashioned, when I state that my decided preference is for an open standpipe overflow.

For baths in public institutions, for baths in factories, and for people's baths, there is a growing tendency to discard the tub bath in favor of the rain or spray bath, which is greatly superior from a sanitary point of view, besides having many economical advantages.

Slop sinks and housemaids' sinks are obtainable in a variety of serviceable forms, most of them excellent from the sanitarian's point of view. I would only remark that a flushing cistern is quite as essential in the case of a slop sink as in that of water closets. An ingenious and novel arrangement consists in a slop sink which flushes itself automatically each time slops are emptied into it.

Kitchen sinks are likewise obtainable in a variety of materials. This fixture is much improved by changing the dribbling stream passing through its waste into a quick and effective flush. Attempts in this direction have been made, with some success, and the devices employed are certainly worth considering. Incidentally the question of avoiding the kitchen grease nuisance is thereby solved, in a better way, to my mind, than by the employment of grease traps at the sinks, which invariably constitute a nuisance, are usually forgotten or neglected, and are not to be recommended. I must content myself with a mere allusion to the subject.

Of urinals it is only necessary to mention that in private houses their use is not to be encouraged, as the fixture is very difficult to keep clean. In offices and in public buildings, such as hotels, railroad stations, court houses, etc., the fixture is a necessity, and great attention is required not only in the fitting up but in its maintenance. The projecting lip of porcelain urinals seems to me to be of doubtful advantage. One point in the fitting up of the fixture is worthy of mention. The bowls are generally set up too high from the floor slab. I find it is better to set them at a height not exceeding 22 inches from the top of lip to floor line, instead of 24–26 inches, as is customary. The floor slab is thereby kept more readily free from drippings.

In fitting up plumbing fixtures the chief aim should always be the avoidance of wood work at and around them. All fixtures should stand free from the walls and accessible on all sides. Even the seats of water closets are now attached directly to the bowl. The closet thus stands absolutely free and detached from the wall and the entire fixture can be reached for cleaning and for repairs. In one respect, however, modern plumbing fixtures are open to considerable improvement. I refer to the undesirable noisiness accompanying the flush and the discharge of the fixtures. This problem, as experience teaches, is not easily solved.

The time at my disposal permits only a brief allusion to the testing of plumbing work. All work should be tested before acceptance, as knowledge of the safety of the plumbing work can only be obtained in this way. I regret to say that I have found only very few mechanics doing plumbing who apply to their work any test except where this is specially insisted upon by the architect or the engineer. To my mind, it is one of the most important duties which architects owe to their client to see to it that all work is tested. For new work we have the water test and the air pressure test. This should include not merely the main horizontal lines and the vertical stacks, but likewise all the branches and the brass ferrule joints. The finished work should be tested by the peppermint or by the smoke test, which help to show imperfections in the joints of nickel plated piping and at the floor joints. In the inspection of old work, the water test, which is the best test, cannot, for obvious reasons, be applied, and here the smoke test, or the test with oil of peppermint, intelligently applied, give valuable indications as to the condition of the work.

A great step forward would be made and plumbing work vastly simplified by abolishing or at least modifying the trap vent system. There are at present two quite different methods of arranging the system of trapping the fixtures in a building. In the one system, which is in accordance with the majority of plumbing regulations, and is the one at present enforced in New York City, all traps must be back aired or vented. We thus obtain a duplicate system of pipe lines, the work is complicated, more expensive, and may become more unsafe, on account of the greater number of pipe joints, and the possibility of by-passes. The other system—the one-pipe system, as we may call it—is distinguished by its greater simplicity, economy and, as I maintain, by its greater safety. This method substitutes non-siphoning traps or anti-siphon trap attachments for the cumbersome method of back airing. In this system all main soil and waste lines must be quite as fully ventilated by extending them the full size up to the roof as in the usual method. All fixtures are located directly at the lines carried up to the roof, or within a very few feet of the same. Siphonage of the traps is impossible under the ordinary conditions, quite as much so as in the back-airing system. You will find the majority of plumbers opposed to the new system; for while it simplifies the work it reduces the amount of piping used and thereby the cost of the work. There is also much prejudice against the proposition, many plumbers seeming to fear that by putting themselves openly on record as in favor of it, they would by others be considered as not quite up to date in plumbing matters. The fact remains undisputed—and I have demonstrated it in many cases in my practice—that the new method is at least quite as safe as the old one. I venture to predict that in a very few years plumbing laws will be so modified as to leave it optional with the owner or architect of a building which method he will adopt.

This leads me to say a few words in regard to plumbing rules and regulations, in particular of those in force in New York City. Further advancement in plumbing requires the revision and improvement of the plumbing laws of the building department. Far be it from me to underrate the good which the present rules have accomplished in the past. Ours is not, however, an age in which we can at any time afford to stand still. Constant progress is made in every department of construction and the researches of the practical sciences are everywhere utilized and embodied in actual practice. Let us hope to see soon a revision of our plumbing laws. Be it remembered that the plumbing rules of our metropolis are being largely copied by other cities. We cannot afford to fall behind in this matter. Our present rules are too indefinite in many details, they are much too arbitrary in others. Take, for instance, the question of sizes of drain pipes, of soil pipes, of vent pipes, the diameter of traps, etc. There is certainly now sufficient practical experience available to lay down more definite rules as to sizes. The rules should also in the future prohibit fixtures which sanitary science has long ago recognized as being absolutely bad. Pan closets, wooden sinks and wooden wash tubs should be discarded and privy sinks should no longer be tolerated.

Before leaving the subject of interior drainage, I wish to consider for just a moment the prevailing practice of doing plumbing work. It is, without doubt, feasible to have plumbing work done by day's work by a contractor of known integrity, at a certain agreed commission or profit on the net cost of labor and material without thereby unduly increasing the cost of the work. Still, as a rule, the owner prefers to make a contract for a lump sum or stated figure. In that case the recent practice, particularly in the case of high office buildings, of putting the plumbing, and, for that matter, the heating and power plant, the electric work and the elevator machinery, in the builder's general contract, for a consideration which usually amounts to much more than the fee of experts who would plan and superintend the work in the owner's interest, cannot be commended. There is not, to my mind, a single feature of merit in it, and there are, on the other hand, good reasons why these branches, which comprise the domestic engineering work of buildings, should be kept separate and under the direct control of the ar-

chitect or the mechanical, electrical or sanitary engineering expert who may be associated with him.

In conclusion let me say a few words about the outside drainage and final disposal of the sewage, particularly of country houses not within reach of sewers. These are questions which rarely concern the architect directly, but about which it is, nevertheless, useful for him to keep informed.

In the case of city houses the outside drainage is apparently a very simple matter, consisting merely in the continuation of the house drain to the public or street sewer. Still, even the sewer connection requires attention, as is proved by a recent case which happened on the upper west side of this city, where a builder and his plumber connected a whole row of dwellings to the pipe sewer in the street by merely breaking holes into the sewer and sticking the house drain through it.

The final disposal of the sewage from habitations becomes a very difficult and sometimes troublesome matter in the case of country and suburban houses not within reach of sewers. The purity of the local water supply must be maintained, the contamination of the soil and likewise the pollution of the air must be prevented at all hazards. To accomplish this the disgusting and health-menacing cesspool and the privy nuisance must be done away with. Bad as a single cesspool is, the evil is only aggravated by the method sometimes pursued of having one cesspool for the water closet wastes and another for the kitchen sink wastes or by having a series of cesspools with connecting overflows.

Two methods of sewage disposal have been devised by engineers which offer a successful solution of the problem. One is the system of sub-surface irrigation, the other the disposal of sewage by irrigation over the surface. Inasmuch as the chief requirements are that sewage be disposed of not alone without injury to health, but also without offense to sight or smell, it is not often practicable to run the sewage over the surface of the ground near the house. Where plenty of land is available and located at such an elevation that sewage can be conducted to it by gravity, surface irrigation is by far the best, the cheapest and the simplest mode of disposal.

The other system, the sub-surface irrigation system, has been in successful use in many country places. It has often been described and illustrated, and in a paper like this it is out of the question to go into details. The chief features of this system are the following:

1. Carry the sewage from the house in a tight pipe conduit leading to a sewage or flush tank.

2. Collect the sewage in a double-chambered tank, the first chamber being intended to retain the solids and kitchen grease, while the second and larger tank receives the liquid sewage by a deeply trapped overflow from the first chamber.

3. Discharge the liquid sewage once or twice a day, by means of an automatic siphon, into an outlet pipe, leading to the sewage field.

4. Distribute the sewage by means of a main conduit with laterals, into a system of absorption drain tiles, laid with open joints, in trenches twelve inches deep, covered up with earth.

I will not describe the details of the system. I wish to warn you, however, against having such work done by contract. Frequently have I been asked by clients and by architects to undertake sewage disposal contracts, but I have always declined to do so. I know that others undertake such contracts, but the results are seldom entirely satisfactory. Often the mistake is made of laying an insufficient number of absorption tiles, with the result that after a season's work the field becomes overcharged with sewage. I also find sewage disposal systems laid out by others giving trouble because the tiles were laid with too steep a grade, in which case it invariably happens that the bulk of the sewage runs to the lowest end of the field, where it often breaks out on the surface. In other instances, again, I find the distributing tiles laid two, three, and sometimes even four feet below the ground surface. This mistake arises from a lack of knowledge of the principles of the system, which require the sewage to be discharged into the upper well-aerated layers of the soil or the sub-surface, where the action of the bacteria converts the sewage and the particles of organic matter attaching to the earth into harmless elements.

A bad layout of the distributing tiles invariably results in failure. Sometimes the system proves unsuccessful from the omission of the first or intercepting chamber, in which case the tiles become choked in a short time. Insufficient attention to the flush tank is another frequent reason why the method fails to give satisfaction. Owners of country houses, after adopting this method of disposal, generally make the mistake of assuming that the same is automatic, and hence needs, after completion, no further attention. The fact is that nothing is automatic in the system except the siphon for emptying the flush tank, but every part of the system, including the siphon, needs attention and intelligent care and occasional cleaning.

As regards the flush tank, it may be either an open or a closed tank, the latter being preferable in all cases where the flush tank must be placed near the house. The open tank, if at a distance from the house, is better, because it is more readily accessible and easier to clean. The tank may be circular in shape or else oblong. It is generally built of brick work, lined with Portland cement. Col. Waring, who introduced this system from England, has suggested lining such open sewage tanks with enameled face brick or with marble. I agree with him that this is quite desirable on the ground of greater cleanliness. But in my own practice I have not been able to meet clients who were willing to incur the extra expense involved, and where I am associated with architects in such work, I find that they prefer putting marble or slate or enameled face brick where it will show to better advantage.

There are a great many other things which I would like to bring before you if time permitted. In closing this paper I thank you for your courteous attention, and trust that some of the points brought up may be new to you, though I fear that to such a progressive body of architects I have but retold an old story.

KRUPP claims to have invented a machine that will roll iron so thin that it would take 1,800 sheets to make an inch.

THE ELECTRIC LIGHT FOR CARRIAGES AND HORSES.

RECENT visitors to Germany, and Berlin in particular, have noticed the large numbers of coupes and open carriages which are lighted with electricity. Many of these carriages are drawn by horses which

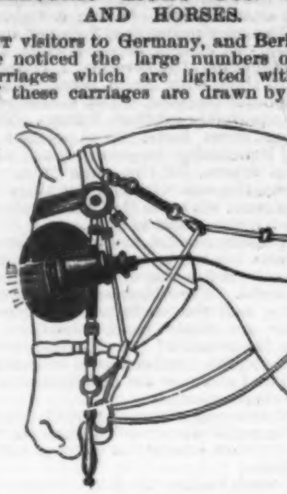


FIG. 1.—BLINDER LAMPS.

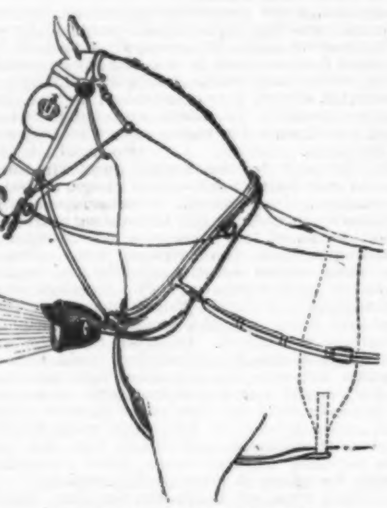


FIG. 2.—BREAST LAMP.

FIG. 3.—STORAGE BATTERIES.

FIG. 4.

FIG. 4.—LAMPS FOR FOUR-IN-HAND TEAMS.

FIG. 5.—POLE LAMP.

have electric lights fastened to their harness, either on the blinders (Fig. 1) or on some part of the collar. These lighting appliances are a specialty of a Berlin firm which furnishes the fittings, lamps, reflectors, and storage batteries. These fittings are made of ebonite, and the wires which convey the current are insulated by rubber tubes which are buried in the harness to protect them. The lamps are connected with the harness by flexible conducting cords. The lamps are lighted by a battery of accumulators of four or six cells (Fig. 3) contained in a small case, weighing forty or fifty pounds. Each element is contained in a hard rubber cell. No acid is used, a gelatinous mass being substituted. The case containing the cells may be placed under the seat of the carriage and is capable of supplying current for twenty ampere hours. The idea has suggested itself to the owners of four-in-hands to equip the coach and harness with fittings for the electric light. Lights were thus fixed in pairs on the collar of each horse (Fig. 4). The Emperor of Germany has twenty hunting carriages provided with a lamp at the end of the pole (Fig. 5). The storage batteries are easily charged before setting out. For our engravings and the particulars given above we are indebted to the Journal Universal d'Electricite.

TELEGRAPHING WITHOUT WIRES.*

RECENTLY several attempts have been made in England to solve the problem of telegraphing between distant points without the employment of metallic conductors. In consequence of the reports which have lately been published in the various electrical journals, I was instructed by the General Electric Society to make a thorough investigation of the various methods which have been used for transmitting signals over interrupted circuits. Pursuant to these instructions, I examined the systems employed by Mr. W. H. Preece, of London, and Mr. Chas. A. Stephenson, of Edinburgh.

The latter, it will be remembered, employs both a static and inductive process. Briefly stated, by alternately charging a cable with positive and negative electricity, he excites currents in a conductor placed at right angles to the charged cable or inductor. It should be noted, however, that the distance between the inducting or primary circuit and the induced or secondary circuit did not exceed 66 yards. Mr. Preece, on the contrary, employed spools of extraordinary dimensions for his inductive telegraphy. The diameter of the coils was 200 yards, and with such enormous apparatus he produced signals in a secondary circuit at a distance of 850 yards.

As is well known, Mr. Preece has also succeeded in establishing telegraphic connection between the coast and outlying islands or signal ships. I refer here especially to his recent experiments between Arran and Kintyre in Scotland, where an inducing circuit of two English miles was constructed about 100 meters above the surface of the ocean. The experimenter states that such an inductor is capable of producing an inductive area of 3,200,000 m^2. In all his experiments telephone receivers took the place of the ordinary Morse sounders.

From a careful study of his work I am convinced that the favorable results attained are largely due to direct current conduction. To verify my opinion, I commenced a course of experimentation, and to prevent inductive efforts in the transmission of intelligence, I decided to use a uniform or straight current.

It is a fact that when a current is sent through two electrodes immersed in a conducting liquid, the electrical equilibrium between these electrodes is not effected in a straight line, but, on the contrary, the stream lines spread out in a manner well illustrated by Fig. 1. Now, if we place in the liquid medium an independent conductor of electricity, it will attract or condense upon its surface a certain number of these stream lines, and these deviated stream lines can be utilized for the excitation of a properly constructed receiving apparatus.

The experiments which I am going to describe are founded upon the physical law which I have mentioned. It is, of course, evident that no inductive phenomena can take place. On the contrary, we deal here with electrical conduction pure and simple. Likewise, the extent of the inducing circuit area and the shape of the inductor are no longer consequential.

Indeed, all we need are two conductors immersed in a liquid; the distance to which electrical effects can be produced is found to depend upon two factors; the available current strength and the distance between the electrodes.

It was thought best to conduct the experiments in the lake Wannsee, near Potsdam, because an electrical light station is situated near the borders of the lake. The arrangement of circuits is shown in Fig. 1.

In it AB signifies a battery of 25 accumulators, SU an interrupter driven by a motor, W resistance coils (0 to 24 ohms), AM an amperemeter, VM a voltmeter, T a Morse key, EP two grounded zinc plates, also connected by cable with the poles of the battery. The inductor circuit comprises two zinc plates, E' P', suspended by cable from two boats distant from 50 to 100 meters; NN are telephone receivers included in this circuit. For the purpose of transmitting signals intermittent currents were sent from the battery which, by the opening or closing of the Morse key, could be transformed into ordinary signals.

My first aim was to establish experimentally the independence of or relation between the various factors, i. e., the relation between the current strength in the primary circuit and limit of hearing distance for the telephones in the secondary circuit; the effect of various distances between the electrodes, E P, upon the clearness of the transmission of signals in the secondary circuit; to find the distance between the plates suspended from the boats which gave the most satisfactory audible effect in the telephone receivers; finally, the effect of altering the shape and size of the electrodes.

On account of the non-delivery of some apparatus especially designed for these tests, the average current strength sent through the water did not exceed three amperes with 150 intermissions or current impulses per second. Again, the water of the Wannsee containing but a very small admixture of mineral salts, it offered a very high resistance to the electrode surfaces, so that I found it necessary to enlarge the zinc plates to 15 m^2 in order to produce a current density of three amperes.

For this experiment the distance between the primary electrodes was about 1,500 feet, and no difficulty was encountered in the exchange of intelligence between the electric light station and the village of Neu

* By Erich Rathenau in Elektrotechnische Zeitschrift.

Gladow, a distance of three miles. The sounds in the receiving telephone resembled a soft humming and buzzing noise, but the telegraph operators read them without any trouble. By slightly changing the ordinary construction of the telephone, signals can be transmitted over a much longer distance.

Lord Rayleigh has stated that the sensitiveness of the telephone for currents with 600 reversals per second is about 600 times greater than for currents having but 130 reversals per second, but in my experiments the number of impulses employed did not exceed 150 per second. To get the best possible result in this system of transmission, a telephone should be used having a carefully tuned metallic tongue in place of the ordinary

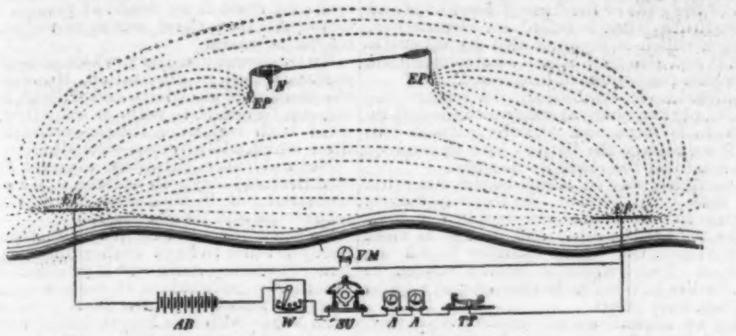


FIG. 1.—TELEGRAPHING WITHOUT WIRES—SHOWING SPREAD OF ELECTRICAL STREAM LINES.

iron disk. Moreover, knowing the number of current breaks in the primary circuit, the tongue should be so tuned as to vibrate in unison with that number, thereby producing much more distinct signals. It does not seem necessary to point out here that by the use of several current generators, each one producing a definite number of current impulses, a number of non-interfering messages may be sent through the water to distant telephones, each being constructed to respond to but one definite rate of vibration; or by means of one current generator a message may be sent to several distant telephone receivers.

I may, however, point out that the resistance of the receiving circuit should be as small as possible. At first I found it difficult to produce a call in the distant receivers, but this apparently knotty problem may be solved by attaching a microphone to the membrane of the receiver, which, acting upon a relay in a local circuit, produces the call.

The usefulness of the above described method of transmission would be much increased if means can be found to produce a written message. On the sugges-

FIG. 2.—TELEGRAPHING WITHOUT WIRES—MAP SHOWING LOCATION OF RATHENAU'S EXPERIMENT.

tion of Dr. Rubens an apparatus is now being constructed, generally on the plan of Dr. Wien's optical telephone. It is expected that the use of this apparatus will enable us to transform the acoustical into optical signals and to register these photographically. To increase the signaling distance, I advise the use of:

1. Great current strength in the primary circuit.
2. Increasing the distance between the primary electrodes.
3. Increasing the distance between the receiving electrodes.
4. Replacing the metallic diaphragm of the telephone receiver by a light tongue.
5. Which should be tuned to respond to a definite rate of vibration.

I am convinced that by skillfully selecting the proper apparatus, the problem of telegraphing without wires between considerable distances offers no further practical difficulty.—Electrical Review.

ELECTRIC ACCUMULATORS UNDER PRESSURE.

As well known in the electrolysis of water by platinum electrodes, the hydrogen and oxygen gases separated by the action of the current do not appear immediately after the establishment of the latter. Moreover, after the breaking of the circuit, a difference of potential persists between the two electrodes, so that, in closing the voltameter upon itself by a conducting wire, a current is produced that is the reverse of that which at first traversed the liquid. These effects are explained by the recombination of the hydrogen and oxygen gases condensed by the platinum. The duration of the current thus obtained is very feeble.

We have thought that by taking as electrodes substances capable of storing up much gas, we should have a chance of obtaining better results as regards the duration and intensity of the discharge current, without meeting with the inconveniences inherent to the Grove gas battery, which gives but an extremely feeble discharge on account of its great internal resistance and the slowness of the recombination of the free gases through the platinum. We first tried spongy platinum. We inclosed a certain quantity of this substance (about 6 grammes) in two small silk bags, into each of which entered a platinum wire designed to lead the current (Fig. 1). These bags, placed in water, acidulated with 1-10 sulphuric acid, and connected with the poles of a battery, were saturated with gas by the passage of the current and furnished a discharge much more intense and more prolonged than that which would have been obtained with the same weight of platinum in the ordinary metallic state and not spongy.

Under these conditions, the apparatus operating like a true condensed gas battery, we thought that a strong pressure would increase the absorbing power of the spongy platinum. In order to verify this, we inclosed the apparatus in a steel reservoir, and, by means of a hydraulic pump, exerted upon it pressures that we carried up to 600 atmospheres (Fig. 1). Just

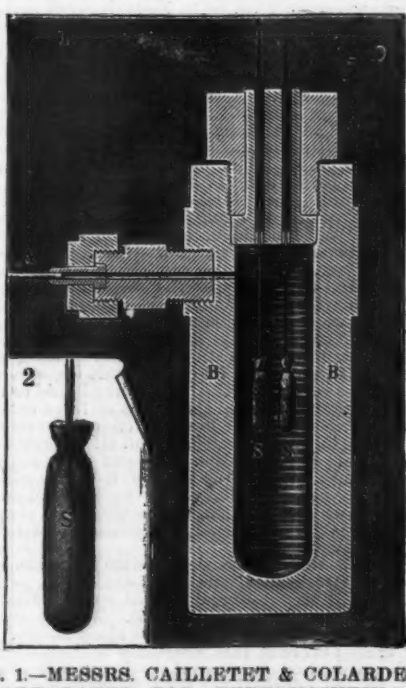


FIG. 1.—MESSRS. CAILLETET & COLARDEAU'S APPARATUS FOR EXPERIMENTING ON ELECTRIC ACCUMULATORS.

No. 1, section.—A, tube leading the pressure from the hydraulic pump; B B, steel cylinder of 1,000 atmospheres' resistance; S S, silk bags containing the metals in a spongy state. No. 2.—One of the bags represented on a larger scale.

as we had supposed, the duration of the discharged current gently increased with the pressure. The apparatus became an accumulator of electric energy capable of lending itself to measurements of capacity, of electromotive force and of discharge.

The curves given in Fig. 2 represent the results obtained with an apparatus containing 6 grammes of platinum and interposed in a discharge circuit of a resistance of 2 ohms. In the vertical axis are shown the intensities of the discharge current and in the horizontal the times. It will be seen that, under the atmospheric pressure, the duration of the discharge is but about ten seconds. The initial e. m. f., equal to 1·8 volt, descends without discontinuity to zero.

If we operate under higher pressures, the velocity of the discharge becomes gradually modified, and comprises three periods: (1) a period of very rapid fall, followed by a slight increase in the intensity of the current; (2) a period of constant intensity that slightly increases with the pressure, and during which period the e. m. f. of the apparatus is approximate to 1 volt; and (3) finally, a new period of fall less rapid than the first.

If we calculate the capacity of the accumulator thus formed, in carrying it to one kilogramme of spongy platinum, we find that it is 56 amperes-hour for a pressure of 580 atmospheres.*

As for the intensity of the discharge current, that may easily reach 100 amperes per kilogramme. Since the inception of our experiments, we have remarked that upon employing equal quantities of spongy platinum for the two poles, the disengagement of the bubbles of hydrogen takes place long before that of the bubbles of oxygen. We have concluded from this that it is necessary to distribute it in unequal quantities between the two poles in order to obtain the best rendering from a given weight of material. We have found that the proportion to be adopted is three parts for the negative pole against one part for the positive. Finally, we have endeavored to ascertain the rendering of the apparatus, that is to say, the ratio of the quantity of electricity restored by the discharge to that furnished by the charge. We have found that such rendering reaches high figures (95 to 98 per cent.) when the charge is not carried to its extreme limits and the discharge immediately succeeds it. When such conditions are not fulfilled, the accumulator gradually dissipates its discharge in open circuit, and the rendering diminishes.

We have submitted several other metals of the platinum group to the same experiments. Mr. Joly, director of the Laboratory of Chemistry of the Normal High School, where we made these researches, has been so good as to prepare for us the necessary quantities of them, and in an extremely pure state.

Iridium has given us results entirely analogous to those of platinum. Ruthenium is slightly attacked at the positive pole by the acid liquid, which becomes of a dark brown color. Despite this, it also condenses the gases of the electrolysis and furnishes an accumulator whose capacity increases with the pressure; but its e. m. f. is not fixed at a constant figure. It decreases in a continuous manner from 1·6 volt to zero, without manifesting any tendency to remain stationary at any moment of the discharge, and that, too, as well at a pressure of 100 atmospheres as at the ordinary pressure.

Of all the metals allied to platinum, palladium is the one that has given us the most interesting results. The condensing properties for hydrogen have been well known since the experiments of Graham. This physicist found no trace of condensed oxygen in the experiments made upon this subject upon plates or wires of this metal. We have, indeed, verified the fact that an accumulator formed of plates of palladium possesses, even under a strong pressure, but an exceedingly feeble capacity, on account of the almost immediate saturation of the positive plate, which allows of the disengagement of free oxygen as soon as the charge current is cut. Upon employing the metal in a spongy state (obtained by the calcination of the cyanide), the results were entirely different, and we obtained effects superior to those given by the other metals of the native alloy of platinum. Even at the ordinary pressure, the accumulator, after having given a period of rapid fall at the discharge, and then a slight superelevation of the intensity of the current, furnishes a constant discharge.† In measure as the pressure increases, we observe the same general effects as with the platinum; but at an equal pressure and with an equal weight of active material, the capacity of the accumulator is from three to four times greater.

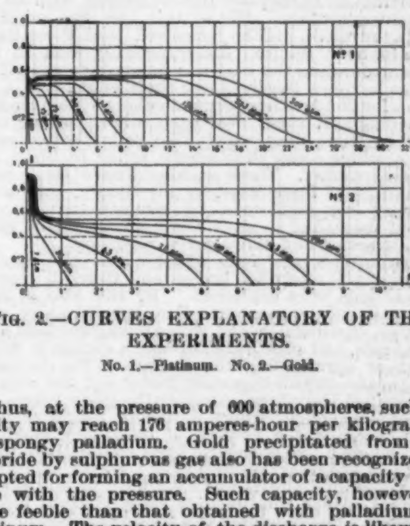


FIG. 2.—CURVES EXPLANATORY OF THE EXPERIMENTS.

No. 1.—Platinum. No. 2.—Gold.

Thus, at the pressure of 600 atmospheres, such capacity may reach 176 amperes-hour per kilogramme of spongy palladium. Gold precipitated from the chloride by sulphurous gas also has been recognized as adapted for forming an accumulator of a capacity variable with the pressure. Such capacity, however, is more feeble than that obtained with palladium or platinum. The velocity of the discharge is likewise a little different from that given by the other metals (Fig. 2, curves No. 2).

Finally, with silver, tin, nickel, and cobalt, which have been tried under the same conditions, there is a chemical alteration of the metal at the positive pole. The same is the case with carbon in its various states. We have again a certain accumulation of electric energy in these bodies, but a strong pressure gives no increase in the results. The effects observed are probably due to an alteration of a chemical nature, like that to which lead accumulators owe their properties. With carbon, in particular, the gas that disengages at the positive pole after the saturation is not pure oxygen, but a mixture of this gas with a very strong proportion of carbonic acid. This result had already been found.

Upon the whole, among the various substances tried, the noble metals not susceptible of altering chemically in contact with the electrolyte or produced by its decomposition seem alone adapted for forming condensed gas accumulators whose capacity increases with the pressure. With some of these metals the capacity

* We know that the practical capacity of industrial lead accumulators varies from 10 to 20 atmospheres per kilogramme. It is well understood, as has been remarked by Mr. Mascart, that the number that we cite for industrial lead accumulators applies to their practical capacity joined to the total weight of the apparatus, and not to the sole weight of the active substance. We have long known that it is impossible to construct lead accumulators that present a greater capacity, but such advantage is counterbalanced by the very rapid putting out of service of these apparatus.

† We have seen that the spongy platinum begins to give this result only starting from 20 to 30 atmospheres.

may reach high figures, and notably superior to those given in ordinary practice by industrial lead accumulators.—Note presented to the Academy of Sciences by Messrs. L. Cailletet and E. Colardeau.—From La Nature.

[FROM THE ENGINEERING MAGAZINE.]

MODERN THEORIES AS TO ELECTRICITY.

By HENRY A. ROWLAND.

IT is not uncommon for electricians to be asked whether modern science has yet determined the nature of electricity, and we often find difficulty in answering the question. When the latter comes from a person of small knowledge which we know to be of a vague and general nature, we naturally answer it in an equally vague and general manner; but when it comes from a student of science, anxious and able to bear the truth, we can now answer with certainty that electricity no longer exists. Electrical phenomena, electrostatic actions, electro-magnetic actions, electrical waves—these still exist and require explanation; but electricity, which according to the old theory is a viscous fluid throwing out little amœba-like arms that stick to neighboring light substances and, contracting, draw them to the electrified body, electricity as a self-repellent fluid or as two kinds of fluid, positive and negative, attracting each other and repelling themselves—this electricity no longer exists. For the name electricity, as used up to the present time, signifies at once that a substance is meant, and there is nothing more certain to-day than that electricity is not a fluid.

This makes the task of one who attempts to explain modern electrical theory a very difficult one, for the idea of electricity as a fluid pervades the whole language of electrical science, and even the definitions of electrical units as adopted by all scientists suggest a fluid theory. No wonder, then, that some practical men have given up in despair and finally concluded that the easiest way to understand a telegraph line is to consider that the earth is a vast reservoir of electrical fluid, which is pumped up to the line wire by the battery and finally descends to its proper level at the distant end. Is not this the proper conclusion to draw from that unfortunate term "electric current"? Remembering this fact—that we cannot yet free ourselves from these old theories and exactly suit our words to our meaning—we shall now try to understand the modern progress in electrical theory.

This whole progress is based upon something in the human mind which warns us against the possibility of attraction at a distance through vacant space. Newton felt this impossibility in the case of gravitation, but it is to Faraday that we must look principally for the idea that electrical and magnetic actions must be carried on by means of a medium filling all space and usually called the ether. The development of this idea leads to the modern theory of electrical phenomena.

Take an ordinary steel magnet and, like Faraday, cover it with a sheet of paper, and upon this sprinkle iron filings. Mapped before us we see Faraday's lines of magnetic force extending from pole to pole. We can calculate the form of these lines on the supposition that a magnetic fluid is either distributed over the poles of the magnet or on its molecules, assuming that attraction takes place through space without an intervening medium. But at this idea the mind of Faraday revolted, and he conceived that these lines, drawn for us by the iron filings, actually exist in the ether surrounding the magnet; he even conceived of them as having a tension along their length and a repulsion for one another perpendicular to their length.

Two magnets, then, near each other, become connected by these lines, which, like little elastic bands always pulling along their length, strive to bring the magnets together. These so-called lines of force (now called tubes of force) were, by his theory, conducted better by iron and worse by bismuth than by the ether of space, and so gave the explanation of magnetic attraction and diamagnetic repulsion.

The same theory of lines of force was also applied by Faraday to electrified bodies, and thus all electrostatic actions were explained. By this idea of lines of force it will be seen that Faraday did away with all action at a distance and with all magnetic and electrical fluids, and substituted instead a system in which the ether surrounding the magnet or the electrified body became the all-important factor and the magnet or electrified body became simply the place where the lines of force ended; where a line of magnetic force ended, there was a portion of imaginary magnetic fluid; where a line of electric force ended, there was a portion of imaginary electric fluid. As the quantities of so-called plus and minus electricity in any system are equal, we can thus imagine every charged electrical system to be composed of a group of tubes of electrical force (more strictly electric induction) which unite the plus and minus electrified bodies, each unit tube having one unit of plus electricity on one end and one unit of minus electricity on the other.

The tension along the tube explains the reason why such an arrangement acts as if there were real plus and minus electrical fluids on the ends of the tube, attracting one another at a distance. Consider a plus electrified sphere far away from other bodies. The lines of force radiate from it in all directions, and being symmetrical around the sphere, they pull it equally in all directions. Now bring near it a minus electrified body, and the lines of force turn toward it and become concentrated on the side of the sphere toward such a body. Hence the lines pull more strongly in the direction of the negative body and the sphere tends to approach it.

In the case of a conducting body the lines of force always pass outward perpendicularly to the surface, and hence, if we know the distribution of the lines over the surface or the so-called surface density of the electricity, we can always tell in which direction the body tends to move. It is not necessary to know whether there are any attracting bodies near the conductor, but only the distribution of the lines. These lines then do away with all necessity for considering action at a distance, for we only have to imagine a kind of ether in which lines of force with given properties can exist and we have the explanation of electric attraction.

But the question now arises as to how the lines of electric force can be produced in the ether, or, in other words, how bodies can be charged.

In the first place, we know that equal quantities of plus and minus electricity are always produced. As an illustration, suppose it is required to charge two balls with electricity. Pass a conducting wire between them with a galvanic battery in its circuit. The galvanic battery generates the lines of force; these crowd together around it and push each other sideways until their ends are pushed down the wire and many of them are pushed out upon the balls.

When the tension backward along the lines of force just balances the forward push of the electromotive force of the battery, equilibrium is established. If the wire is a good conductor, there may be electrical oscillations before the lines come to rest in a given position, and this I shall consider below.

The motion of the ends of the lines of force over and in the wire constitutes what is called an electric current in the wire, which is accompanied by magnetic action around it and also by waves of electro-magnetic disturbance, which pass outward into space.

If, after equilibrium is established, we remove the wire, we have simply two charged spheres connected by lines of electrostatic force and thereby attracted to each other. If we replace the battery by a dynamo or by an electric machine, the effect is the same.

But there is another way by which bodies are often charged and that is by friction. In this case we can suppose the glass to take hold of one end of the lines of force and the rubber the other end, and it is then only necessary to pull the bodies asunder to fill the space with lines. The friction is merely needed to bring the two bodies into intimate contact and remove them gently from each other.

The following considerations may guide us in understanding the details of the process. It is well known from Faraday's researches that a given quantity of electricity has a fixed relation to the chemical equivalents of substances. Thus it requires 10,000 absolute electro-magnetic units of electricity to deposit 114 grammes of silver, 68 grammes of copper, 34 grammes of zinc, etc.

Hence we can consider, for instance, in chloride of silver that the atoms of silver are joined to the atoms of chlorine by lines of electrostatic force which hold them to each other. If, by rubbing the chloride of silver, we could remove the chlorine on the rubber while leaving the silver, we could stretch them asunder and so fill space with the lines of electrostatic force. According to this theory, then, each atom has a number of lines of force attached to it, and it is only by stretching the atoms apart that we can fill an appreciable space with them and so cause electrostatic action at a distance.

We come to the conclusion, then, that all electrification is originally produced by separating the atoms of bodies from one another, which can be done by breaking contact, by friction, or by direct chemical action of one substance on another, or in some manner not so common. The lines of electrostatic force in a case of electricity at rest must always begin and end on matter, and they can never have their ends in space free from matter. The ends can be carried along with the matter, constituting electric convection, or they can slide through a metallic conductor or an electrolyte or rarefied gas, making what we call an electric current; but as they cannot end in a vacuum, they cannot pass through it. Thus we conclude that a vacuum is a perfect non-conductor of electricity.

The exact process by which the ends of the lines of force pass through and along a conductor can at present be only dimly imagined, and no existing theory can be considered as entirely satisfactory. In the case of an electrolyte, however, we can form a fairly perfect picture of what takes place as the decomposition goes on. Thus, in the case of zinc and copper in hydrochloric acid, we can imagine the zinc plate attracting the chlorine of the acid, thus stretching out the natural line of electric force connecting the chlorine atom and the first hydrogen atom; we can imagine the atoms of chlorine and hydrogen in the body of the liquid recombining with each other and their lines of force uniting until they form a complete line long enough to stretch from the zinc to the copper plate; and all without once making a line of force without its end upon matter. We can further imagine the ends of this line sliding along the copper and zinc plates to the conducting wires and down their length, thus making an electric current and carrying the energy of chemical action to a great distance.

If the ends of the lines should slide along the wire without any resistance, the wire would be a perfect conductor; but all substances present some resistance, and in this case heat is generated. This we always find where an electric current passes along a wire. As to the exact nature of this resistance or the nature of metallic conduction in general we know little, but I believe we are approaching the time when we can at least imagine what happens in this most interesting case.

Besides the heating due to the electric current, steadily flowing, we must now account for the magnetic lines of force surrounding the current and the magnetic induction of one current on the other.

If the current is produced by the ends of the tubes of electrostatic force moving along the wire, then we may imagine that the movement of the lines of electrostatic force in space produces the lines of magnetic force in a direction at right angles to the motion and to the direction of the lines of electrostatic force. At the same time we must be careful not to assume too readily that one is the cause and the other the effect: for we well know that a moving line of magnetic force (more properly induction) produces, as Faraday and Maxwell have shown, an electric force perpendicular to the magnetic line and to the direction of motion. Neither line can move without being accompanied by the other, and we can, for the moment, imagine either one as the cause of the other. However, for steady currents, it is simpler to take the moving lines of electrostatic force as the cause and the magnetic lines as the effect.

We have now to consider what happens when we have to deal with variable currents rather than steady ones.

In this case we know from the calculations of the great Maxwell and the demonstrations of Hertz that waves of electro-magnetic disturbance are given out. To produce these waves, however, very violent disturbances are necessary. A fan waved gently in the air scarcely produces the mildest sort of waves, while a bee, with comparatively small wings moved quickly and vigorously, emits a loud sound.

So with electricity, we must have a very violent electrical vibration before waves carrying much energy are given out.

Such a vibration we find when a spark passes from one conductor to another. The electrical system may be small in size, but the immensely rapid vibrations of millions of times per second, like the quick vibration of a bee's wing, sends out a volume of waves that a slowly moving current is not capable of producing. The velocity of these waves is now known to be very nearly 300,000 kilometers per second. This is exactly the velocity of waves of light or other radiation in general, and there is no doubt at present in the minds of physicists that these waves of radiation are electro-magnetic waves.

By this great discovery, which almost equals in importance that of gravitation, Maxwell has connected the theories of electricity and of light, and no theory of one can be complete without the other. Indeed, they must both rest upon the properties of the same medium which fills all space—the ether.

Not only must this ether account for all ordinary electrical and magnetic actions, and for light and other radiation, but it must also account for the earth's magnetism and for gravitation.

To account for the earth's magnetism, we must suppose the ether to have such properties that the rotation of ordinary matter in it produces magnetism. To account for gravitation, it must have such properties that two masses of matter in it tend to move toward each other with the known law of force, and without any loss of time in the action of the force. We know that moving electrical or magnetic bodies require a time, represented by the velocity of light, before they can attract each other in the line joining them; but for gravitation no time is allowable for the propagation of the attraction.

But the problem is not so hopeless as it at first appears. Have we not in two hundred and fifty years ascended from the idea of a viscous fluid surrounding the electrified body and protruding arms outward to draw in the light surrounding bodies to the grand idea of a universal medium, which shall account for electricity, magnetism, light and gravitation?

The theory of electricity and magnetism reduces itself, then, to the theory of the ether and its connection with ordinary matter, which we imagine to be always immersed in it. The ether is the medium by which alone one portion of matter can act upon another portion at a distance through apparently vacant space.

Let us then attempt to see in greater detail what the ether must explain in order that we may, if possible, imagine its nature.

1st. It must be able to explain electrostatic attraction. These electrostatic forces are mostly rather feeble as we ordinarily see them. Air breaks down and a spark passes when the tension on the ether amounts to about $\frac{1}{100}$ pound to the square inch. It is the air, however, that causes the break-down. Take the air entirely away, and we then know no limit to this force. In a suitable liquid it may amount to 500 times that in air, or 5 pounds to 1 square inch, and become a very strong force indeed. In a perfect vacuum the limit is unknown, but it cannot be less than in a liquid, and may thus possibly amount to hundreds, if not thousands, of pounds to the square inch.

2d. It must explain magnetic action. These actions are apparently stronger than electrostatic actions, but in reality they are not necessarily so. A tension on the ether of only a few hundred pounds on the square inch will account for all magnetic attraction that we know of, although we are able to fix no limit to the force the ether will sustain. No signs have ever been discovered of the ether breaking down.

Again, we must be able to account for the magnetic rotation of polarized light as it passes through the magnetic field; and it can only be accounted for by assuming a rotation around the lines of magnetic force. This action, however, takes place only while the lines of magnetic force pass through matter, and it has never been observed in the ether itself. The velocity of rotation, however, is immense, the plane of polarization rotating in some cases 300,000,000 times per second.

The ether must also account for the earth's magnetism. If we assume that magnetic lines of force are simply vortex filaments in the ether, we have only to suppose that the ether is carried around by the rotation of the earth, and we have the explanation needed. The magnetism of the earth would then be simply a whirlpool in the ether.

3d. The ether must be able to transmit to a distance an immense amount of energy either by means of electro-magnetic waves in light or by the similar action which takes place in the ether surrounding a wire carrying an electric current.

The amount of energy which can be transmitted by the ether in this manner is enormous, far exceeding that which can be carried by anything composed of ordinary matter. Thus take the case of sunlight: on the earth's surface illuminated by strong sunlight a horse power of energy falls on every seven square feet. At the surface of the sun the ethereal waves carry energy outward at the rate of nearly 8,000 horse power per square foot!

Again, an electric wire as large as a knitting needle, surrounded with a tube half an inch in diameter in which a perfect vacuum has been made to prevent the escape of electricity, may convey to a distance a thousand horse power, indeed even ten thousand or more horse power, there being apparently no limit to the amount the ether can carry.

Compare this with the steam engine, where only a few hundred horse power requires an enormous and clumsy steam pipe. Or, again, the amount carried by a steel shaft, which, at ordinary rate of speed, would require to be about a foot in diameter to transmit 10,000 horse power.

When we compare the energy transmitted through a square foot of ether in waves, as in the case of the sun, with the amount that can be conveyed by means of sound waves in air or even sound waves in steel, the comparison becomes simply ridiculous, the ether being so immensely superior. As quick as light, the ether sends its wave energy to the distance of a million miles

while the sluggard air carries it one. Thus, with equal strain on each, the ether carries away a million times the energy that the air could do.

4th. The ether must account for gravitation. For this purpose we are allowed no time whatever to transmit the attraction. As soon as the position of two bodies is altered, just so soon must the line of action from one to the other be in the straight line between them.

If this were not so, the motion of the planets around the sun would be greatly altered. Toward the invention of such an ether, capable of carrying on all these actions at once, the minds of many scientific men are bent. Now and then we are able to give the ether such properties as to explain one or two of the phenomena, but we always come into conflict with other phenomena that equally demand explanation.

There is one trouble about the ether which is rather difficult to explain, and that is the fact that it does not seem to concentrate itself about the heavenly bodies. As far as we are able to test the point, light passes in a straight line through space even when near one of the larger planets, unless the latter possesses an atmosphere. This could hardly happen unless the ether was entirely incompressible or else possessed no weight.

If the ether is the cause of gravitation, however, it is placed outside the category of ordinary matter, and it may thus have no weight although still having inertia—a thing impossible for ordinary matter where the weight is always exactly proportional to inertia.

Ether, then, is not matter, but something on which many of the properties of matter depend.

It is curious to note that Newton conceived of a theory of gravitation based on the ether, which he supposed to be more rare around ordinary matter than in free space. But the above considerations would cause the rejection of such a theory. We have absolutely no adequate theory of gravitation as produced by the ether.

To explain magnetism, physicists usually look to some rotation in the ether. The magnetic rotation of the plane of polarization of light, together with the fact of the mere rotation of ordinary matter, as exemplified by the earth's magnetism, both point to rotation in the ether as the cause of magnetism. A smoke ring gives, to some extent, the modern idea of a magnetic line of force. It is a vortex filament in the ether.

Electrostatic action is more difficult to explain, and we have hardly got further than the vague idea that it is due to some sort of elastic yielding in the ether.

Light and radiation in general are explained when we understand clearly magnetic and electrostatic actions, as the two are linked together with certainty by Maxwell's theory.

Where is the genius who will give us an ether that will reconcile all these phenomena with one another and show that they all come from the properties of one simple fluid filling all space, the life blood of the universe—the ether?

A NEW SERIES OF NITROGEN COMPOUNDS.

ANOTHER new series of nitrogen compounds, containing four atoms of that element along with one atom of carbon in a closed chain, are described by Prof. v. Pechmann and Herr Runge in the current Berichte. They are termed "tetrazolium" compounds, and the parent base of the series is tetrazolium hydroxide, whose constitution is represented by the formula

$$HC\begin{array}{l}\diagup N-NH \\ \qquad\quad | \\ \diagdown N=N\begin{array}{l}\diagup H \\ \diagdown OH\end{array}\end{array}$$

The fundamental base itself has not yet been isolated; the compounds prepared comprise the derivative in which the two hydrogen atoms directly attached to the two end nitrogen atoms are replaced by phenyl, together with a large number of salts of this base, formed by replacement of the hydroxyl by halogens or other acid radicals, just as in the case of metallic hydroxides. The hydrogen atom attached to the carbon is likewise capable of replacement by many organic radicals, so that a large number of still more complicated bases have likewise been prepared, together with their corresponding salts. The hydroxides of this new series are characterized by possessing strong basic properties. They may all be prepared most conveniently from their chlorides, by the action upon them of silver oxide. They are extremely soluble in water, but are completely precipitated from their solutions by ether. The aqueous solutions absorb carbon dioxide and behave very much like caustic alkalies. They cannot, however, be crystallized, forming resins upon concentration. The salts, on the other hand, crystallize admirably; they are usually soluble in water, react neutral to litmus, and possess a very bitter taste. Diphenyl tetrazolium chloride,

$$HC\begin{array}{l}\diagup N-NPh \\ \qquad\quad | \\ \diagdown N=N\begin{array}{l}\diagup Ph \\ \diagdown Cl\end{array}\end{array}$$

which may be taken as a typical salt of the series, crystallizes in colorless radiating groups of needles very sensitive to light, which renders them yellow. The aqueous solution yields a flesh-colored precipitate of chloroplatinate with platinum chloride, and the double salt may be crystallized from hot water. A crystalline double chloride is likewise produced with gold chloride. The addition of a soluble nitrate or iodide causes the precipitation of the difficultly soluble nitrate or iodide of the base. A solution of iodine in potassium iodide precipitates an iodine addition product, which can be crystallized from alcohol in beautiful brown tabular crystals exhibiting a violet reflection. The parent base is produced in solution upon the addition of silver oxide, silver chloride being likewise formed. The chloride is reduced by ammonium sulphide to a compound of the constitution:

$$HC\begin{array}{l}\diagup N-NHPh \\ \diagdown N=NPh\end{array}$$

a substance which Prof. v. Pechmann has previously described, and which is interesting as forming the starting point for the preparation of the new series. For the chloride may at once be prepared from this latter substance by oxidation with amyl nitrite and hydrochloric acid. The substance is readily prepared by the action of diazobenzene chloride upon malonic acid, constituting the insoluble product of the reaction. It is of considerable interest to observe that the main product of the dry distillation of diphenyl tetrazolium chloride is azobenzene.—Nature.

SPOTS AND STRIPES IN MAMMALS.

By R. LYDEKKER, B.A.Cantab., F.R.S.

THOSE of our readers who have considered the subject at all are probably aware that, in those animals whose fur is ornamented with dark or light markings, these markings generally take the form either of longitudinal or transverse bands or of spots; the latter being frequently arranged in more or less distinctly defined longitudinal lines, but never in transverse bands. Moreover, these markings, especially in the case of stripes and bands, are generally most developed on the upper surface of the body, although spots may be equally present on both the upper and the lower surfaces of the body. Many mammals, again, whether they be spotted or whether they be striped, have their tails marked by dark rings on a light ground; but this feature is also present in others in which the color of the body is of a uniform tint. It must not, however, be supposed that there is any sharply defined distinction between spotted and striped mammals, many of the civets, as well as some of the cats, having markings intermediate between true spots and stripes. Spots, again, are somewhat variable in configuration, some animals, like the hunting leopard, having solid circular dark spots, while in others, such as the leopard and jaguar, they assume the form of dark rings inclosing a light center. In other cases, as in the giraffe, the spots are enlarged, so as to form large and more or less quadrangular blotches.

A survey of a museum or a menagerie will likewise show that spots and stripes are by no means equally prevalent in all groups of mammals. In the apes, monkeys, marmosets and lemurs, for instance, they never occur; and when these animals are diversely colored, the coloration takes the form of patches symmetrically disposed on the two sides of the body, but otherwise not following any very clearly defined mode of arrangement. Then, again, in the hoofed mammals or ungulates, many species are more or less uniformly colored; although the zebras are notable instances of transversely striped animals, while the giraffe is an equally marked example of the blotched type of coloration. Among the even-toed (Artiodactyle) subdivision of this order it may be also noticed that while in the more specialized forms, such as wild cattle and sheep, the coloration is more or less uniform, many of the antelopes show white transverse stripes on a dark ground.

Dark transverse stripes are, however, known only in the case of the little zebra-antelope (Cephalophus doriæ) of western Africa and the gnus; while, although a lateral dark flank stripe is present in some antelopes, and in the gazelles, none of these animals have the whole body marked by longitudinal dark stripes. In the case of the deer, it may be observed that a few species, like the fallow deer and the Indian spotted deer, are marked with longitudinal rows of white spots at all ages; while, if the former be examined, it will be found that in many instances the young are similarly marked, whereas the adults are uniformly colored. A similar state of things occurs among wild pigs and also in the tapirs, from which we are naturally led to infer that in this group of mammals, at least, a spotted or striped type of coloration is the original or generalized condition, while a uniformly colored coat is an acquired or specialized feature. And we shall find that this will hold good for other groups.

Turning to the carnivorous mammals, we shall find that in many families, more especially the cats, hyenas, and civets, stripes and spots are far more generally present than a uniform coloration; although some groups, such as the bears, form a marked exception to this rule, the majority of the species being uniformly colored, while none are striped or spotted. In some species of the weasel family—notably the badgers—it may be also noticed that while the sides of the head are marked by longitudinal dark and light stripes, the remainder of the body is uniformly colored. And it may be mentioned here that many animals, such as donkeys and dun-colored horses, retain a longitudinal dark stripe down the back, frequently accompanied by dark transverse bars on the limbs, while a uniform coloration prevails elsewhere.

In the gnawing mammals, or rodents, although many species are uniformly colored, stripes and spots are prevalent; and a survey of the collection of these animals in a good museum will show that, whether the pattern take the form of stripes or spots, the arrangement is invariably longitudinal and never transverse; and it may be observed that when spots are present, these are invariably light colored on a darker ground. Although in many cases the longitudinal stripes occupy the whole or a considerable portion of the upper surface, in some of the squirrels they are reduced to a dark and light stripe or even a single light stripe on each flank, this remarkable type of coloration recalling the "speculum" on the wing of a duck.

We might extend our survey to other orders of mammals, but sufficient has been said to indicate the variability of the prevalent type of coloration in different groups, and we may accordingly now proceed to give a list of some more or less well-known mammals arranged according to the plan of their markings.

1. Mammals with dark longitudinal stripes.—Striped mangooses (Galidictis), of Madagascar, in one of which the stripes are very narrow and close, while in the other they are broader and more widely separated; these animals belonging to the civet family. The three-striped palm civet (Arctogale). The genet, the markings here tending to break up into spots. The three-striped opossum. The palm squirrel and chipmunks (Tamias).

In all the above the stripes are dark upon a grayish ground, but in the following they take the form of black and white stripes, the white area being generally the larger; and it may be noted that all belong to the weasel family. They include the skunks, the South African weasel (Pœcilogale), and the Cape polecat (Ictionyx); while similar markings obtain on the head of the badger.

2. Mammals with dark spots.—These may be divided into several sub-groups, according to the form of the spots. Those in which the spots are small, more or less nearly circular, and solid, include the hunting leopard, the tiger cat, the lynx, the spotted hyena, the large spotted civet (Viverra megaspila), the African linsang (Poiana), and the young of the puma. The blotched genet (Genetta tigrina) forms a transition to blotches. While some of the civets are more or less distinctly spotted, in others the coloration is intermediate between spots and longitudinal stripes.

As species in which the spots are enlarged to form more or less quadrangular blotches, we may cite the giraffe and those Oriental civets known as linsangs.

By a splitting up of a simple spot into a more or less complete ring of smaller ones, we have the rosette-like type of ornamentation, as exemplified in the leopard, the snow leopard and the jaguar. In the two former the ring incloses a uniform light area; but in the latter the central area generally carries one or more dark spots. A further development of the ring leads to the so-called clouded type, as displayed by the Oriental clouded leopard, the marbled cat and the American ocelot. Here the ring becomes enlarged into a large squarish or oblong area, inclosing an area of darker hue than the general ground color of the fur and bordered by a narrow black line; the black line in the two former species being, however, confined to the hinder half of the cloudings.

3. Mammals with dark transverse stripes.—Tiger, young lions, wild cat, striped hyena, aard wolf (Proteles), banded civet (Hemigale), banded mangoose (Crossarchus), zebra-antelope, gnus, zebras, thylacine and the water opossum (Chironectes). Among these, it may be noted that in the zebras the stripes on the hind quarters have a more or less marked longitudinal direction, and whereas in the true zebra and Grévy's zebra they consist of simple dark bands on a light ground, in Burchell's zebra the light areas between the dark stripes are traversed by an intermediate stripe of somewhat darker hue than the ground color.

4. Mammals with white spots arranged in longitudinal lines.—Fallow deer and Indian spotted deer; young tapirs; the paca (Cœlogenys) among the rodents, and the dasyures among the marsupials. Both in young tapirs and the paca the spots tend to coalesce into more or less complete longitudinal stripes.

5. Mammals with white transverse bands.—The kudu, eland, bongo (Tragelaphus angasi), and harnessed antelope (T. scriptus) among the antelopes, and Gunn's bandicoot (Perameles gunni) and the banded anteater (Myrmecobius) among the marsupials. In the harnessed antelope spots occur as well as stripes.

Many other species might be incorporated in these lists, but the foregoing instances are sufficient to show that no one type of coloration is confined to any particular group, although it may be much more common in one assemblage of animals than in another.

Several attempts have been made to reduce the coloration of animals to some general law, and among these one of the most notable was published some years ago by Prof. Eimer, of Tubingen, who based his conclusions on a comprehensive study of vertebrates in general. As the result of his investigations, this observer declared that the following laws might be laid down in regard to color markings of animals in general:

First, the primitive type of coloration took the form of longitudinal stripes. Secondly, these stripes broke up into spots, retaining in many cases a more or less distinct longitudinal arrangement. Thirdly, the spots again coalesced, but this time into transverse stripes. And fourthly, all markings disappeared, so as to produce a uniform coloration of the whole coat.

As a further development of this theory, it was added that the more specialized features were assumed in many cases more completely by the male than the female, while the primitive coloration often persists in the young. And it was stated that the primitive longitudinal stripes frequently persist on the middle of the back and likewise on the crown and sides of the face. Examples of the latter survival being shown by the head and face stripes of many spotted cats, and the dark and light streaks on the sides of the face of the badger.

Whether these laws hold good for other groups of vertebrates, it is not within the scope of the present article to inquire, and attention will accordingly be concentrated on mammals. If they be true, we should, prima facie, expect to find a large number of longitudinally striped forms among the lower members of the class; while those of intermediate grades of evolution would be spotted, and the higher types either transversely striped or uniformly colored.

This, however, could only be the case, as a whole, if all mammals formed one regularly ascending series; whereas, as a matter of fact, they form a number of divergent branches, each containing specialized and generalized forms. The inquiry is thus rendered one of extreme complexity, although there ought, if the theory were true in its entirety, to be a considerable number of longitudinally striped species among the lowest groups of all. Unfortunately, palæontology, from the nature of the case, can afford us no aid, which fact very materially adds to the difficulty.

It may be added that in Prof. Eimer's scheme no distinction is drawn between light and dark markings—that is to say between the total disappearance of pigment and an ultra-development of the same—and it is obvious that this may be of such prime importance that these two types of coloration have nothing whatever to do with one another. Nevertheless, we may provisionally consider light and dark stripes, and light and dark spots, as respectively equivalent to one another.

With regard to uniformly colored animals, there can be no question as to the truth of the theory, since the young of so many animals, such as lions, pumas, deer, pigs, and tapirs, show more or less marked striped or spotted markings which disappear more or less completely in the adult. The occurrence of bands on the legs and sometimes on the shoulders of mules and dun-colored horses, and likewise the presence of dark bars on the limbs of otherwise uniformly colored species of cats, like the Caffre cat and the bay cat, are further proofs of the same law. Moreover, the fact that in the young of pigs—and to a certain extent those of tapirs—the markings take the form of longitudinal stripes,

whereas in the more specialized deer, whether young or old, they are in the shape of spots arranged in more or less well-defined lines, is, as far as it goes, a confirmation of the theory that spots are newer than stripes. And the presence of transverse stripes in the still more highly specialized antelopes tends to support the derivation of this type of marking from spots, especially if it be remembered that the harnessed antelopes are partly spotted. Still, it must be borne in mind that these instances apply only to light markings, which, as already stated, may have a totally different origin from dark ones.

There are, however, apparently insuperable difficulties as regards longitudinal and transverse striping in mammals. In the first place, instead of finding a number of the polyprotodont, or more primitive marsupials, showing longitudinal stripes, we have in this group only the three-striped and single-striped opossums thus marked, and in these the stripes are respectively reduced to the numbers indicated by their names. This, however, is not all, for the banded anteater—the most primitive of all living mammals (with the exception of the egg-laying mammals)—takes its name from the narrow transverse white stripes with which the back is marked; while the thylacine, which cannot in any sense be regarded as a specialized type, is similarly marked with broader dark stripes; neither of these animals having any trace of a longitudinal stripe down the back. The water opossum, again, may be regarded as a transversely striped marsupial, although here the stripes are few in number, and approximate in form to blotches. Although in the same order the dasyures are spotted with white, we have no black-spotted marsupial; and if such a type formed the transition between longitudinal and transverse stripes, surely some species showing such a type of coloration ought to have persisted.

Then, again, in the ungulates we have the zebra-antelope, the gnus, and the zebras showing most strongly marked transverse dark stripes; but we have no dark-spotted forms in the whole order except the giraffes, while the only ones with dark longitudinal stripes are young pigs. And it would thus appear that, although all the animals above mentioned are highly specialized species, these transverse stripes and dark blotches must have originated de novo quite independently in each of the groups in question. Indeed, when we remember that the coloration of both the zebras and the giraffes is generally stated to be of a protective nature—the stripes of the former rendering the animals invisible on sandy ground in moonlight, and to a great extent also in sunlight, while the blotches of the latter harmonize exactly with the checkered shade thrown by the mimosa trees among which they feed—it is incredible that both types should have been evolved, according to a rigid rule, from animals marked by dark longitudinal stripes.

Another instance of the same nature is afforded by the cats, in most of which the coloration appears to be mainly of a protective nature; plain-colored species, like the puma and lion, having tawny coats harmonizing with the sandy deserts which these animals often inhabit, while the vertical stripes of the tiger resemble the perpendicular lights and shadows of a grass jungle. The clouded markings of the marbled cat and clouded leopard assimilate with the boughs on which these species repose, and the spotted pelage of the Indian desert cat renders the creature almost invisible in stony deserts. To suppose that all such adaptations have been produced in the regular order required by the theory is as incredible as in the last case. There is, moreover, the circumstance that the young of the uniformly colored puma are spotted, thus giving an instance of the direct passage from a spotted to a plain-colored form without the intervention of a transversely striped stage; precisely the same thing also occurring in the case of the deer.

If we look for the most primitive mammals with longitudinal dark stripes over the greater part of the upper surface, such types being wanting in the marsupials, we shall find them in the striped mangooses (Galidictis) of Madagascar, already mentioned. And as the civets and allies are certainly the most generalized of existing carnivora (although that order occupies a somewhat high position), this case tends, in a certain degree, to lend some support to the view that longitudinal dark stripes are an early type. The rarity of animals exhibiting this pattern over all their bodies, coupled with the frequent retention of a longitudinal dorsal stripe, are likewise in some degree confirmatory of the same view. With regard to the conspicuous black and white stripes on the cheeks of the badger, and throughout the head and body in the skunks, South African weasel, and Cape polecat, it may also be argued, with some show of reason, that we have an old type of coloration. In the ancestors of the badger such a type may have been found too conspicuous, and accordingly have been removed except from the face; whereas in the other forms, all of which are more or less evil-smelling creatures, a conspicuous coloration is an advantage, as warning off other animals from attacking them in mistake for harmless kinds, and the boldly alternating stripes have accordingly been retained and rendered as conspicuous as possible.

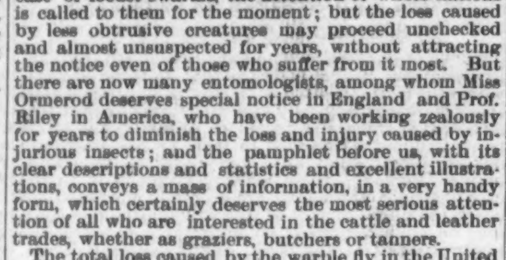
Did space permit, we might dilate to almost any extent on the subject of spots and stripes; but sufficient has, we hope, been said to indicate the interest attaching to the coloration of mammals, and to show how far we are from understanding the causes and modes which have brought about the present state of things. That uniformly colored mammals form the climax of color evolution in the case of stripes and spots may be pretty safely admitted. It may further be considered probable that longitudinal dark stripes are an old type of coloration in at least some groups, although it does not follow that this will hold good for all, the marsupials being possibly an exception. Transverse stripes cannot, however, be made to accord with Prof. Eimer's theory, since not only do they exist in some of the most primitive of all mammals, but they reappear in certain specialized groups where there is no evidence of a previous spotted stage having been passed through. While, therefore, far from improbable that there may be a certain substratum of truth in what we may call the "longitudinal-spotted-transverse-uniform" theory of coloration, we submit that in its present guise it cannot adequately explain the whole evolution of "spots and stripes in mammals."—Knowledge.

THE WARBLE FLY.*

IT is only within comparatively recent years that much attention has been paid to the insect pests of the farm and garden. It is true that when these assume unusually devastating proportions, especially when they make their appearance suddenly, as in the case of locust swarms, the attention of whole nations is called to them for the moment; but the loss caused by less obtrusive creatures may proceed unchecked and almost unsuspected for years, without attracting the notice even of those who suffer from it most. But there are now many entomologists, among whom Miss Ormerod deserves special notice in England and Prof. Riley in America, who have been working zealously for years to diminish the loss and injury caused by injurious insects; and the pamphlet before us, with its clear descriptions and statistics and excellent illustrations, conveys a mass of information, in a very handy form, which certainly deserves the most serious attention of all who are interested in the cattle and leather trades, whether as graziers, butchers or tanners.

The total loss caused by the warble fly in the United Kingdom alone is estimated at something like £8,000,000 per annum, an enormous amount, but which the facts given in Miss Ormerod's pamphlet fully appear to bear out. When hides are sometimes so deteriorated that the loss on each may be as much as from twenty-five to thirty shillings, to say nothing of hides rendered utterly worthless; cattle killed, or the best parts of the carcass destroyed, and diminished yield of milk, the importance of the matter becomes very apparent. And beyond this there remains a very serious question which Miss Ormerod has not touched upon at all: how far the milk of badly infested cows, or the apparently sound portions of a carcass, even when all the obviously diseased part has been conscientiously removed, may be liable to cause disease in man—disease, possibly, of a nature the origin of which is at present absolutely unknown and unsuspected by medical men. And yet we remember once to have met with the statement that the best hides generally contained warbles. This, however, if true in any sense, could only mean that the fly attacks the strongest and healthiest animals in preference to weaker ones, thereby, of course, increasing the mischief produced by its attacks.

Although the insect is so abundant that as many as 500 maggots have been found in a single hide, yet the fly is rarely seen. When the cattle are attacked by it they gallop wildly about, with their tails in the air, and seek the shelter of trees or sheds, or rush into the



HYPODERMA BOVIS.

1, egg; 2, maggot; 3 and 4, chrysalis case; 5 and 6, fly; 3 and 5 natural size, after Bracy Clark; the other figures, after Brauer, and all magnified.

water; and in any of these situations, the fly does not appear to follow them. Cattle will act in the same manner when attacked by true gad flies, one of the largest British species of which, Tabanus bovinus, is likewise noticed and figured by Miss Ormerod in her pamphlet. The gad flies, however, simply pierce the skin of the cattle and suck their blood, but inflict no permanent injury; and their larvæ are subterranean, and not epizootic.

According to the observations of Prof. Riley in America, the egg of the warble fly is deposited on, and not under, the skin. In the earliest stage of the maggot, which Miss Ormerod has herself observed, it is a small blood-red, worm-like creature, scarcely visible to the naked eye, embedded in a slight swelling, composed of blood-red tissue, through which a fine channel, no wider than a hair, passes up to the surface of the skin. In the very young stage, the maggot, which always rests with its head at the bottom of the sore, and the breathing apparatus, which is at the opposite extremity of the body, directed toward the opening which communicates with the external air, is provided with two forks or diggers, probably used for piercing through the substance of the hide. In this stage, too, the maggots are capable of inflating themselves with fluid which they have apparently no means of discharging, and become so hard that they can scarcely be compressed with the fingers, thus forming living and growing plugs, which act the part of setons, and which cannot be pressed back out of the wound, more especially as they are furnished with short bands of prickles along a portion of the back. Having penetrated the hide, the maggot rests in the sore, and presently assumes a more pear-shaped form.

When about one-third grown, a great change takes place in the structure of the creature, which, while it was forcing its passage, was "little more than a bag of fluid, with a large proportion of the space occupied by breathing tubes" At this stage, however, "the hard tips necessary, or at least serviceable for forcing a passage up the hide, are no longer needed, and they are exchanged for a broad form of spiracle, and the internal organs become suited to provide material for the development of the fly, which will presently form in the dry husk of the maggot, which serves as the chrysalis case."

The further development of the maggot is so well known that we scarcely need trace its course until it reaches its final shape of a hairy two-winged fly, not very unlike a small humble-bee in general appearance, nor need we go into the elaborate accounts of the enormous loss which is frequently caused by it to all persons interested in living or dead cattle. The fly appears to be found in most parts of the world, but is a much greater pest in some countries than in others; and it is worthy of notice that while goats appear to suffer from the warble as much or more than cattle, horses seem never to be attacked by it.

Miss Ormerod, however, gives several easy, harmless and efficacious methods by which the mischief may be abated or removed; and the fly appears to be sluggish and not to stray far from where it lived as a maggot, for after a few years' careful destruction of the maggots, the pest seems to disappear, without the farm being liable to fresh incursions from surrounding farms where similar precautions have not been taken to exterminate the maggots. Miss Ormerod has evidently done her best to show the farmers how they may best exterminate the pest; and if they do not avail themselves of the information which she has been at so much trouble to collect and to disseminate, it will not be her fault. The accompanying illustration is from her useful pamphlet.—W. F. Kirby, in Nature.

* "Observations on Warble Fly or Ox Bot Fly (Hypoderma bovis, De Geer)." By Eleanor A. Ormerod, F.R.Met.Soc., etc. London: Simpkin, Marshall, Hamilton, Kent & Co., Limited, 1894.

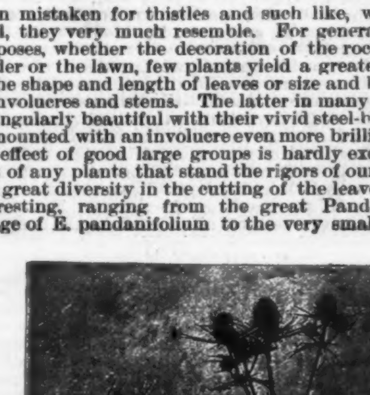
SEA HOLLIES.

(ERYNGIUM.)

THIS genus belongs to the Umbellifers, but is so unlike that class of plants in general appearance as to be

THE COMMON SEA HOLLY (E. MARITIMUM).

often mistaken for thistles and such like, which, indeed, they very much resemble. For general garden purposes, whether the decoration of the rockery, the border or the lawn, few plants yield a greater variety in the shape and length of leaves or size and brilliancy of involucres and stems. The latter in many cases are so singularly beautiful with their vivid steel-blue tints, surmounted with an involucre even more brilliant, that the effect of good large groups is hardly excelled by that of any plants that stand the rigors of our climate. The great diversity in the cutting of the leaves is very interesting, ranging from the great Pandanus-like foliage of E. pandanifolium to the very small thistle-



THE AMETHYST SEA HOLLY (E. AMETHYSTINUM).

like leaves of E. dichotomum. Those belonging to the Pandanus set, such as E. Lasseauxi, eburneum, bromeliæfolium, and others, are useful in sub-tropical arrangements; their leaves being mostly of a thick succulent or leathery nature, are not liable to be damaged by the cold nights in early autumn; indeed, in all but very damp places or heavy soils they continue effective as regards foliage all through the winter season. E. alpinum, Olivierianum, giganteum, etc., are very useful for furnishing the mixed border or rockery, and all are the more valuable for this purpose owing to the length of time they continue in bloom, and in the latter set especially for the long time they retain their handsome blue tints. A good rich but well-drained soil suits most of the species; the latter especially should be attended to, as damp carries off more of the tender species during winter than cold. Coddling is a great mistake, as the sea hollies will stand any amount of exposure so long as the drainage is perfect. In localities

where the rainfall is great, a square of glass over the crown is very useful. E. alpinum may be made an exception to the above directions, as in the south of England at any rate it prefers a shady spot in a good stiff soil. Much the same treatment will also answer in the case of E. Olivierianum.

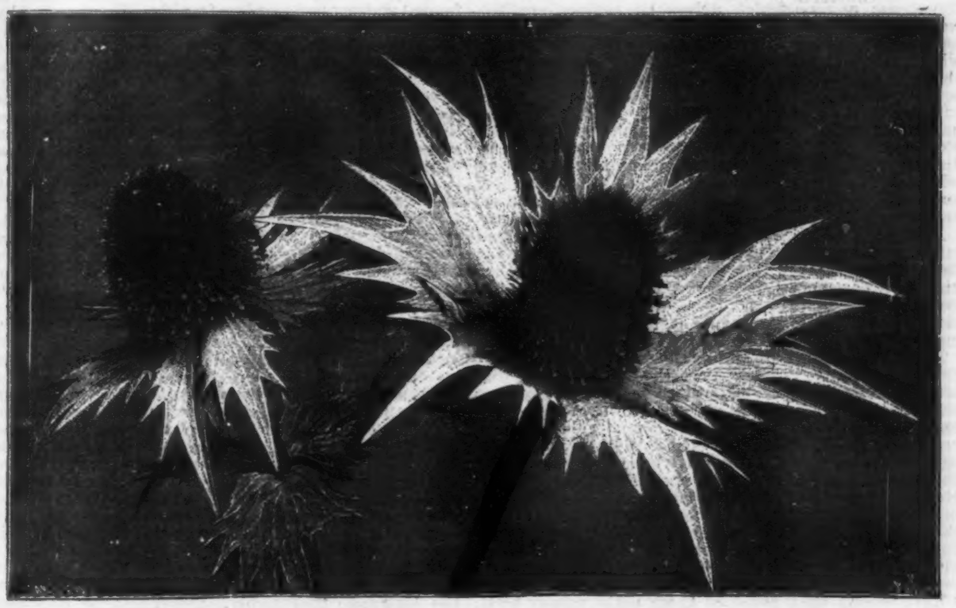
The only safe way to increase these sea hollies is by means of seed. Some few sorts may be increased by division or root cuttings, but they take such a long time to recover, that a healthy, vigorous batch may be raised from seed in about the same time. Sow the seed in pans as soon as gathered, and place in a cold frame. The seeds will germinate in the spring, and if properly managed will be ready to plant out the following year.

The under-mentioned are a few of the most suitable for ornamental purposes:

THE ALPINE SEA HOLLY (E. alpinum).—This is found in the Alpine pastures of Switzerland, Piedmont, etc., and when well grown, is certainly not surpassed in beauty by any plant in the genus. In addition to this, it does well in shady borders, developing a tint almost equal to that when the plant is fully exposed to sunshine. The involucres, as well as the stems, are of a beautiful blue, making a handsome group. Its flower-stems, averaging about 2 feet high, are produced during July and August. There is said to be a white variety.

THE AMETHYST SEA HOLLY (E. amethystinum).—This has been unaccountably confounded with the much more robust E. Olivierianum, although they have little in common. E. amethystinum rarely exceeds 1 foot to 1½ feet in height, is of a somewhat straggling habit, and has flower heads and stems of the finest amethyst blue. Apart from the great beauty of its flower heads and stems, this plant is chiefly welcome on account of its pretty dwarf habit. It answers well for a first or second row in the border, and makes on the rockery one of the most charming little groups that could be desired. It can be increased by division, but is so easily raised from seed, that disturbing the established plants is hardly desirable. It flowers during July and August, and is a native of Dalmatia, Croatia, etc.

THE GIANT SEA HOLLY (E. giganteum).—This deserves notice from the fact that it does well in almost all positions and varieties of soil. The large flower heads are also greatly appreciated for winter decoration; and although not highly colored like those of many of the others, they make pretty bouquets arranged with grasses, etc. It is an excellent plant for grouping, and in large masses it forms a very picturesque object. It grows from 3 feet to 4 feet in height, with stout stems and numerous deeply-lobed, spiny, glaucous leaves. The involucre, of eight to nine large, oval, spiny leaves, pale gray or glaucous, is very effective. A native of the Caucasian Alps, Armenia, Siberia, etc.



THE GIANT SEA HOLLY (E. GIGANTEUM).

THE COMMON SEA HOLLY (E. maritimum).—This plant is still found growing along the coast in company with the oyster plant (Mertensia maritima). It, however, requires no special culture, and does well on a rockery in a stiff, loamy soil. It is one of the most glaucous of the species. It flowers from July to October and grows from 6 inches to 1½ feet high.

OLIVIER'S SEA HOLLY (E. Olivierianum).—This variety can be highly recommended. It is of easy cultivation, and the abundance of its highly-colored flower heads renders it very attractive in the flower border. It has often been, and is even yet, confounded with the amethyst sea holly. E. Olivierianum grows 2 feet to 3 feet and often 4 feet in height. The ten to twelve bracts composing the involucre are longer than the head of flowers and have about half a dozen teeth on each side. In habit and general appearance it is more nearly allied to E. alpinum than any of the others. It, however, appears to be constant to the above characters even under good cultivation. It ripens seed freely, and in this way it may be readily increased. Native of the Levant.

Others equally attractive and desirable are E. Bourgati, campestre, cæruleum, planum, of which there is a very beautiful variety, dichotomum, triquetrum, creticum, glaciale, spina album, etc.

THE PANDANUS GROUP.

To this group, chiefly natives of Mexico, Brazil, etc., belong some of the most curious and extraordinary, as well as some of the most useful forms in this highly ornamental genus. Beginning with serra, we have a large, broad leaved species with curious double spines; Carrierei, said to be the finest of all, having a compact habit combined with large, beautiful leaves. E. bromeliæfolium is a charming plant, striking and distinct in habit and forming elegant yucca-like tufts, with its graceful leaves surmounted with whitish flower heads. E. pandanifolium is a noble-habited plant, very effective when grown as an isolated plant on a lawn. E. Lasseauxi is nearly allied and perfectly hardy in the open air. E. eberneum, aquaticum, virginianum, Leavenworthi and others are all worthy of attention for sub-tropical purposes.—D. Dewar, in the Garden.

THE CHOICE OF BOOKS.

EMERSON said: "A student's library dwindles down to a few books, the Bible, Plato and Shakespeare." Horace Greeley, in his "Recollections of a Busy Life," says he had but few books, but those he had he read over and over again in his boyhood, that he went far and near to find a new book to read. Bacon said: "Some books are to be tasted, others to be swallowed, and some few to be chewed and digested." There is an old saying, "The man is known by the company he keeps." A man's books are his company, his consolation and his friend. Teachers and professors will tell very soon whether the students that come before them are out of families who associate with books. It makes a great difference whether students are from homes where books are considered the most essential furnishings in the family, where culture is hereditary, or from pioneer settlements which have not outgrown the hard struggle for livelihood. The culture that comes from books reaches through more than one generation and the inspiration spreads wider than the influence of a single individual. A good book is a perpetual teacher. A man or woman may be false to you, but a worthy book never deceives. There is no doubt that to a real seer, even the very face of a student and genuine lover of books looks like the spirit of the books that he has read. How could it be otherwise, when the soul always impresses itself upon the body in which it lives? It is the light which shines through the eye in love or hate, in dream or purpose. The thoughts we think and the feeling which fills our hearts become a part of the blood that courses in our veins.

The poets that we read quicken every impulse, open the eye of the soul in imagination and often unite the heart of the reader to the heart of the poet, as two lives moving on, hand in hand, in one common union of purpose, thinking the same thoughts, feeling with the same sympathy, breathing the common air of love, will grow to look alike. Just so a sensitive soul becomes like the truth it gathers from the books it reads. Thus it is found from the spirit of each writer, a cosmopolitan in the world of thought and feeling. If a man is known by the company he keeps, the student may well be known by the books he reads. It is a great art to know how to buy books, and a library wisely selected is an evidence of culture and education that no man can borrow or buy. Money may pay for the books and the cases, but that fine instinct and judgment which are found only in the genuine lover of the best in human thought are a priceless inheritance. To know books is an acquired and cultivated talent. "Good books," said Horace Mann, "are to the young mind what the warm sun and refreshing rain of spring are to the seed which have lain dormant during the frosts of winter." "A little library growing larger every year is an honorable part of a man's history," said Beecher. "It is a man's duty to have books. A library is not a luxury, but one of the necessaries of life." A book is a record of things, acts or feelings and not the things themselves. In some instances books are the setting of gems. Some books are the scavenger's receptacle for his wares, and are to be avoided as a pesthouse. Books are the reflex of the minds of men and differ as the faces and character of their authors. Some books are the parents of our souls, or, rather, they are like Buddha, almost even like Christ, the savior of intellectual life. Think as you step into your library that you are in the company of the choicest spirits that ever walked the earth, seers, philosophers, poets, and that here before you are the panoramas and the revelations of their inner life.

Said Dr. Johnson: "Read anything five hours a day and you will soon be a learned man." That should be taken with limitation, for in the days of Dr. Johnson the world was not flooded with cheap books. The books should be selected by winnowing as the wheat is selected from the chaff. Time is the stuff life is made of, and life is worth too much to be wasted on cheap books. The soul should be fed on inspiration, on things immortal to you. Every young man should be richer after reading a book, and more thankful because a teacher has spoken to you. Every young man should be educated in books, and he should own his own books, mark them, comment upon them, talk with them as with intimate friends. There is an aristocracy in books which should be cultivated. The souls of the writers will vitalize your own soul; they will lift you up into better manners, grander purpose, broader comprehension of man, principles, cause and effect, and God. A thinker should be married to his library; it should be the only creature of which his wife may be jealous. Books are the records of the acts, thoughts, and feelings of mankind. They review to us the thoughts and remarks of the immortals. Books are the treasure houses where the jewels of all time are preserved and the doors are opened only to students and thinkers.—Cleveland Plain Dealer.

[FROM THE NEW YORK SUN.]

THE NEWSPAPER, AND THE ART OF MAKING IT.*

By CHARLES A. DANA.

MR. PRESIDENT, LADIES AND GENTLEMEN: I esteem myself very fortunate in being permitted to be here on this day, in this famous university and in the presence of its officers and its students, to join with you heartily in the celebration of this anniversary.

Every age and every stage of social evolution requires and produces new exemplars and new leaders, men better suited than others to the work that age has to do, to the business it has in hand in the vast drama of man's existence upon earth. Two men, two kinds of men, seem to me especially the guides, the leaders, the servants, the benefactors, of the present day; and the first of these is the man of thought, of science, the man who grasps the secrets of nature, and who brings out new methods and new appliances by which they are converted into agents of human use. Consider, for instance, what such a man as Edison does for the world, or a man like Tesla, who is bending all the faculties of original genius to give us new means and new powers, so that the abilities and the resources of humanity are doubled or quintupled, and men become able to live better upon this planet and to leave behind them the faculty of still better living for those who are to follow after.

That is one class of men that I refer to, the thinkers, the men of science, the inventors; and the other class is that of those whom God has endowed with a genius for saving, for getting rich, for bringing wealth together, for accumulating and concentrating money, men against whom it is now fashionable to declaim, and against whom legislation is sometimes directed. And yet is there any benefactor of humanity who is to be envied in his achievements, and in the memory and the monuments he has left behind him, more than Ezra Cornell? [Applause.] Or, to take another example, that is here before our eyes, more than Henry W. Sage? These are men who knew how to get rich, because they had been endowed with that faculty, and when they had got rich, they knew how to give it for great public enterprises, for uses that will remain living, immortal as long as man remains upon the earth. The men of genius and the men of money, those who prepare new agencies of life, and those who accumulate and save the money for great enterprises and great public works, these are the peculiar and the inestimable leaders of the world, as the twentieth century is opening upon us.

It is expected that I shall say something here to-day about the newspaper and the art of making it. The newspaper is an article of primary necessity. You must have your breakfast, but you must have your newspaper too. Without it we don't know what has happened in the world, we don't know what new ideas, we don't know what shocking events, we don't know what well founded or what fantastical hopes are looming before the minds of the masses of men. We don't even know who is married. Now in these remarks that I shall attempt to make, there will be necessarily a great many details and a great many small circumstances; and I shall be indebted to any one who does not see exactly the fact that I am stating, or who wants some further explanation of it, if he will interrupt me and get up and put his question. The result may not be exactly a lecture, but a kind of academic conversation that may be more lively and more useful than a formal discourse.

The newspaper profession is certainly a learned profession in one sense. It is a profession in which the utmost amount of learning can be put to use. But at the same time I am sorry to say, that there are newspapers in which learning is very sparingly applied, and more facts and better logic would be an improvement. But a newspaper is very much like human nature; it is right sometimes, and it is wrong pretty often. [Laughter.] But, on the whole, there is no question that the newspaper is not only a needful institution, but that it is a useful, advantageous, and beneficial institution.

Just now the business of making newspapers is going through a revolution; it is passing through changes of a very radical and remarkable nature. These changes are due first, to the invention of new printing machinery which makes it possible to publish the large editions and the large newspapers that we see all around us. Before these machines were invented it was not possible to do this, and a machine, an old fashioned press that could turn out 600 or 700 copies a day from the hands of the operator, was the best there was in the world.

Now, the most improved presses, and I say frankly that the best that we have are those made by Hoe in New York, can turn out at one impression large sheets of eight, ten, or twelve pages and deliver 20,000 finished papers in an hour. We hear sometimes figures more surprising, but that is about the maximum of safe and good work. One peculiarity of these machines is that the papers are not only printed, and printed well, but they are folded by the machine; and, what is more, they are counted and laid out in piles of a cer-

* An address, delivered at Cornell University, on Founders' Day, Friday, January 11, 1895.

tain number, so that when the dealer who buys them comes to the office to get his papers, he does not need to count them; they are all counted and ready for him to take away. When I was in the Tribune, thirty years ago, we had to employ men to count the papers after they were printed, and it was a very important duty. If they made a mistake of any moment, there would be trouble. But now there is no mistake possible. The papers are handsomely folded, and they are laid down and counted, so that the dealer picks out his pile and goes away certain that he has got just what he has bought.

Next to the press comes the typesetting machine. We who have reached a certain maturity of life grew up in the impression that a machine to set type was something impracticable. In fact, ever since I was a boy, I have known men trying to make them, and not willing to set their failures down as real failure. But, as a matter of fact, it is not more than fifteen years, let us say, since a machine, operated with keys like a piano, was actually invented that could set up type by mechanical means, and furnish matter set up and corrected, and ready to be put upon the press. There are a good many of these machines of very different nature and operation. The one that is now most in use is the invention of a man of talent named Mergenthaler. By that machine the type are set up, a line is formed and corrected, just one line at a time, and then with melted metal a cast of that line is made, so that instead of a mass of type you can take in your hands what printers call a slug; and then they go on and make another until the whole article and the whole page is put together, ready to be used on the presses. Then there is another machine which a certain literary gentleman named Mark Twain—I presume most of you have heard of Mark Twain [laughter]—is interested in. He has spent a good deal of money on the invention, and I am glad to say that he has had it to spend, all created from the brain of a man of genius. It is a machine of exceeding delicacy, and it does exactly what the human fingers do. It picks up the type and puts it in the box and secures it there, so that finally the column, the article, can be put into the form and the impression be made. It seems to do all that a man can do by mechanism.

I should have said that with all the modern printing machinery no types are put upon the press to be printed. A stereotype plate, usually of a whole page, is made, with a curve in its shape that will fit the press, and from that the printing is done. But this gentleman, this friend of Mark Twain, sets his type up one by one by his machine, and that is put into the form, and the stereotype plate of the whole page is made from that. Then there are half a dozen other inventions, but the most successful one so far, the one that is in use in a great many newspaper offices, is that of Mergenthaler, or, as it is commonly called, the Linotype machine. I have never taken to that very much, because it didn't seem to me to turn out a page as handsome, in a typographical point of view, as a page set up by hand. The difference in expense is something considerable, however. I have been told by one large newspaper publisher who employs that machine, that he gets his typesetting done for one-half the cost of typesetting done by hand. Mr. Whitelaw Reid, of the Tribune, thought that he had it for less than half.

Of course the effect of using these mechanical typesetters is to cheapen the newspaper when it is done and ready for sale. But the great revolutionary agent is the cheapness we have reached in the cost of paper. I remember very well when paper was made of rags, and presently it became evident that the country and all countries didn't supply rags enough. The manufacturers couldn't get the rags, and so we were liable to be left without paper. Then there came along a Frenchman who invented a chemical method of making paper from rye straw; and I remember that the value of rye straw here in the interior of New York rose all at once from $6 to $20 a ton because of the demand created for it to make paper with. That, however, was not the end of the movement. The rye straw always had, after it was converted into paper, a silicious surface, a flinty, glassy surface, and that wore the type out, so that a set of type for a newspaper, that ought to last a year, wouldn't last more than three months. But then came the great change of all, when people turned from the rye field and its straw to the forests. And now all printing paper that is used in newspapers is made out of wood; and when you pick up your paper in the morning to look at it, the probability is that you are picking up a piece of spruce tree from Norway, or that you have got hold of a spruce taken out of the Adirondack country, or wherever in North America spruce timber can be found. A few years ago a man conceived that he had invented an immense thing that was sure to give new value to the big swamps along the Mississippi. From Illinois down to the mouth of the Mississippi there are immense forests, growing almost everywhere on each side of the river, chiefly of a sort of poplar known as cottonwood, and he was going to make paper out of that. He did the thing, but the paper was too good, and the cost price was too high, and I do not imagine that any paper of that very fine sort is now used. What we all employ is made, as I have said, out of spruce trees, or pine trees, or almost any kind of soft wood. They put it through a mill and grind it up into powder, as fine as flour, and then it is converted into pulp, and from that the paper is made; and the manufacturers of paper now generally buy their material in the form of pulp. You know there is a justly distinguished statesman of New York, who instead of being called by his first name, has been popularly known as Wood Pulp. He has contributed much toward making newspapers and toward diffusing views which do not always agree with his own. Yet he is all right. We owe him gratitude, and I desire to pay in all sincerity my share of this general tribute.

You will perhaps be able to appreciate the importance of the revolution a little better when I tell you that the cost of paper for making newspapers which, thirty years ago, was 12 to 20 cents a pound, has steadily declined until now we buy it for 2¼ cents a pound. Twenty years ago our weekly paper bill was the heaviest bill we had to pay, but now it is one of the light ones. For 2¼ cents you get a pound of paper all fit and ready to be printed. One pound of this paper will give you, taking a page the size of the Tribune, fifty-five or sixty pages; and as a week day edition of the Tribune is generally twelve pages, you see you get five or six printed sheets out of the 2¼ cents. That makes the business profitable. The Tribune is retailed at three cents, and it is sold at wholesale for something like 2¼ cents—I don't know precisely how much, but it is 2¼ to 2¾ cents; and there you have a very handsome difference between the money expended for the paper, and the money that is taken in for the printed journal. Now this is a revolution of great consequence in the business of newspaper making. How far it will tend to produce any greater cheapness of newspapers, I will not now attempt to say. They are already sold very cheap considering their other expenses besides the printing and the paper, such as the variety of intelligence, the cost of getting news, the salaries of writers, correspondents, and assistant editors, and the rent that must be paid in a great city for the extensive quarters that are required. That is a very serious item. For instance, there is the New York Times, one of the ablest and most trustworthy newspapers in the world, whose company has lately been reorganized, so that unlike some of the other large newspapers, the company does not own the building it occupies. It has to pay $40,000 rent for the quarters to transact its business in, and I don't think that is excessive. Most of the large newspapers, the Herald, the Tribune, the Sun, own their own buildings. But, taking everything, I should say that the actual capital needed and employed in carrying on one of these big establishments is not less than a million dollars. That is necessary, not to pay the natural losses of an enterprise just begun, but to carry on the regular business, to run the work at a reasonable cost, so that you are not swallowed up by expenses that might be avoided. If you ask how much it would cost to establish a new journal entirely, why, then you have got to have a great deal more money; but a million is the least with which a suitable outfit can be procured. You must have at least four of those big presses, costing $45,000 apiece. Then you must have electric lighting, and the outfit for that costs something considerable. After you have it, it doesn't cost you much to produce the electricity; that is, after you have got the plant. The dynamo is run by the steam engine which drives the presses, and the waste power that would not be used at all suffices to keep the dynamo going and to light your whole house with electricity. There is a notable advantage in electricity for lighting a newspaper office. In fact, it is indispensable. The only other means is gas. In the summer, when the weather is hot, if your printers have their desks lighted with gas, the heat becomes difficult to bear. When we used to employ gas, in July and August, there would scarcely be a hot night when one or two of our men wouldn't faint almost away. But now it is all done with electricity, and we have no trouble or inconvenience from excessive heat.

Now what I have said relates to the mechanical and intellectual features of making a newspaper; but there is a question which precedes it, namely: What kind of a newspaper will you make? and that question may be divided into two parts: First, will you make a newspaper for sensible people? or will you make a newspaper for fools?

Now I would not be understood as intimating that there is anything unworthy or below anybody's dignity in making a newspaper for fools. In the first place, there is impressive evidence to show that the fools form a large part of any community; and we have most unquestionable testimony when we turn to the Prophet Isaiah, the greatest, the most inspired, and the noblest imagination of all the millennial prophets. He says emphatically, in speaking of the Way of Holiness, the "wayfaring men, though fools, shall not err therein." So that it is perfectly right to provide for the fools in special newspapers; and that duty, as you may have noticed, is extensively and conscientiously performed, by gifted and conspicuous individuals, and I have heard that some of them make money by it. [Laughter.] For my part, however, I find more entertainment in making a newspaper that tries to be of the other kind. And as, undoubtedly, some of the intelligent young men whose faces I gaze upon are bound to adopt the profession of making newspapers, I suggest to them that before they make up their minds and come to a conclusion on this important question they should reflect carefully which kind they find most agreeable for their own reading.

The Sunday newspaper is a rather conspicuous object, and I have heard a good deal of discussion about it: such as whether it is right to make a Sunday newspaper; and if it is not right to make it, is it right to read it? I don't think anybody should become a party to a thing that is wrong, by going and buying a newspaper that ought not to be made at all. [Laughter.] But this debate, we may perhaps say, has in great part been settled; and although objectors to the Sunday newspapers are still to be found, the public at large seems to have decided that they want them and will have them. Any way, it is an interesting circumstance that almost every large newspaper whose daily edition we will say sells 50,000 copies at two or three cents, sells on Sunday an edition of 100,000 or 125,000, or 150,000 at five cents, four cents or three cents and three-quarters being the wholesale price. Now, as long as the people will buy the Sunday papers, I suppose they will be made. At the same time, considered as a question of conscience, and of moral and social duty, I am bound to say that I cannot yield to the objection. I do not see anything wrong either in making or in reading a Sunday newspaper. In fact, if I found anything noxious in the Sunday newspaper I should be ready to denounce it; yet, while there is liable to be something you would wish to have changed in any newspaper, and in every newspaper, we do not find any special fault in the Sunday newspaper. It is a picture of the world as it is; of the good men and of the bad men, the virtues and the crimes; and as the crimes of half a dozen are more startling and tend more to arrest our attention than the virtues of a thousand good men, it is to the crimes that a great deal of attention is necessarily paid. But is it wrong to report and to publish these things? Everybody will talk about them. The newspapers could not suppress them if they would; and if any one newspaper regularly omitted to give an account of interesting swindles, or forgeries, or murders, the people would stop reading that paper and go off and get one where they could find all the news. Besides, I have been led to conclude, in reasoning upon this subject, that if the Divine Providence permits such things to happen, we, who are merely the witnesses of its operation, may certainly stop a moment and report the facts to each other.

Now a newspaper is naturally the organ of a party, political or other. Its editors, its conductors, hold certain ideas, certain principles, certain social, political, religious principles; and in discussing the events of the times, they will express those principles. Now, ought a newspaper stick to its party always? Here we will suppose is an editor who is an advocate of what is called free trade. Some of you people understand what that means, I presume [laughter]; and he is in the habit of presenting the good effect which the adoption of free trade would have. He goes, therefore, with the party that is most favorable to free trade. But by and by the party professing free trade does not do it; what is he going to say then? Shall he stand by the party or shall he express his own sincere, honest sentiment, and say the party is wrong, and he is against it in that thing? Well, now, human nature is so constituted and the weaknesses of men's hearts—I don't think the women's hearts are so weak in that way [laughter]—lead them often to stay in a club, a church, or any organization that they do not agree with any longer. But it seems to me that with a newspaper there ought to be some dividing line, some certain point where it will manifest its independence, if it does not violently declare it. There should be in the editor, the public guide, a power of determination, and there should be intelligence. He should know what his principles are and he should express them clearly so that other people may know them. There should be faithfulness, and not a new illustration of what Ben Wade, old Senator Wade, of Ohio, said in the Senate one day, speaking of Senator Benjamin, of Louisiana, when he described him as "a Hebrew with Egyptian principles." [Great laughter.] At that very time there were plenty of such Hebrews, and there were plenty of Northern newspapers and politicians hating slavery in their hearts, who stood up and, without a blush, pressed by necessity, defended slavery more or less frankly. Now I do not like it. The newspaper must be independent of its party, or it is not the ideal sort of newspaper that we want to praise very much. And nobody who remembers it can ever forget—I am sure that my friend Mr. Sage remembers it distinctly—that noble utterance of Horace Greeley when the Whig party had nominated General Scott on a pro-slavery platform. Greeley said: "I spit on the platform!" He was hotly abused, and yet he remained a member of the party, and nobody thought of turning him out, hardly even when he afterward became a Democratic candidate.

Now, allow me a word as to the education that a young journalist should work for. In the first place, he should learn everything that it is possible for him to know. I never saw a newspaper man who knew too much, except those who knew too many things that were not so. [Laughter.] I am myself a partisan of the strict, old-fashioned classical education. The man who knows Greek and Latin, and knows it, I don't mean who has read six books of Virgil for a college examination, but the man who can pick up Virgil or Tacitus without going to his dictionary; and the man who can read the Iliad in Greek without boggling, and if he can read Aristotle and Plato, all the better: that man may be trusted to edit a newspaper. But above all he should know his own language, the English language. The more you understand it, the more you go down into the depths of it, the more familiar you are with the roots and the complications and the developments of it, the more you will look at it with wonder and admiration. The man who is going to publish a daily manual of news and facts and ideas and truths, or even lies, in that language, should know the language thoroughly. Otherwise he may sometimes say what he does not mean. I have known that to happen. I remember once we had in the Tribune a smart young fellow named Henderson. He was afterward a rather conspicuous Republican politician in Michigan. He had written something one day that Mr. Greeley didn't like. Greeley came in and said, "Henderson, did you write that?" "Yes, sir," said he. "Go away from here! I don't want you here any more. I discharge you!" The next morning I came down to the office and found Henderson sitting at his desk and working tranquilly away as usual. I said, "How is this? I thought Mr. Greeley discharged you."

"Yes, sir, he did; but I didn't put confidence in all that he said." [Great laughter.]

Then there are a great many sciences of the present day that the young newspaper man ought to learn. He ought to know the practical sciences above all, especially chemistry and electricity; history he should know, too, particularly American history, the American constitution and constitutional law. About political economy I don't speak so emphatically. Carlyle said it was a dismal science, and I have noticed that a great many young men who had studied it very carefully, and who could discuss it with much emphasis, didn't always seem to know so much themselves. But it is there, and it must be attended to, no doubt. [Laughter.]

The earlier discussions about the art and science of making newspapers have dwelt always upon the importance of looking out for the news, and not being beaten in the news. That is certainly very desirable; but fortunately the procuring of the news is provided for by news agencies or associations, in which several newspapers combine and provide for supplying themselves with the news; so that the editor of each individual paper is left in comparative leisure to attend to study and discussion and the more important duties that he has on his hands. For instance, within the last two years some eight or ten papers in the city of New York have organized an association for supplying themselves with the news of New York and its vicinity. Formerly we each of us kept half a dozen reporters, I don't know how many, who were employed for that particular duty; but now this association, conducted by these united newspapers, provides every one with all the news that is to be found, and they are all supplied at reduced expense. Moreover, the same system prevails with regard to the general news of the world and the country. For instance, the next day after an

election in the State of New York, we are able, through the operation of this associative arrangement, to publish the figures of every place in the State, every county, every important town, every voting precinct, if that should be necessary. That emancipates the manager of the paper and the editor of the paper from the necessity of the strenuous attention, the watchful vigilance, which they formerly were obliged to apply to their news columns. So that now they can make the paper more interesting by correspondence and literary or scientific or romantic articles, and they can do it in the same time that used to be absorbed in getting the petty news of the town and in reporting, for instance, that Mrs. McTabby had fallen down in the street and broken her toe. The consequence is that not quite so many men are employed on the newspapers, but they are apt to be better educated and more capable men. I ought to have said, when I was speaking of the decline in the cost of making newspapers, that it has not been accompanied by a decline in the salaries of the men employed, but rather by an increase of them. The writers, correspondents, reporters, although considerably affected by the hard times that we have had during the past two years, are, on the whole, better paid than they were five years before. But when I say men, I am guilty of a little inaccuracy. There are now a great many ladies employed on the newspapers, not only in New York City, but, I dare say, almost everywhere else. They are employed as reporters, as writers, as artists, and they are valuable assistants in almost every department. There is only one difficulty about it; they don't stay. When you have found a lady about whom you are convinced it is impossible to replace her, then she goes and marries some rich man, especially if she is pretty: and there the poor editor is left, helpless and without consolation. [Laughter.]

Another interesting question is the illustrations, the pictures. You have noticed, of course, that all the newspapers now abound in pictures, and there is no newspaper so poor that it can't print just as many pictures as it likes. Twenty years ago, if we wanted to print the portrait of any distinguished man, Senator Hill or Mr. Cleveland, for instance, why, we had first to get a photograph, then we had to get a draughtsman, then a wood engraver, and then, after the engraving was cut in the wood, we had to have a stereotype made of it before we could print it. It was a very expensive operation. I should think, to make a good and adequately extensive portrait of Mr. Cleveland, after the old fashion, would cost $40 or $50; while now, such is the progress of the practical sciences and arts, we don't need to have a wood engraver at all. You don't even need a draughtsman. You put your photograph by means of the photographic camera on a zinc plate, which is prepared for the purpose you require. That is, it is covered with a gelatinous and sensitized substance sufficiently thick for the purpose. On that you put your photograph, and then you apply an acid which eats the features of Mr. Cleveland and his noble figure into the zinc plate; and there it is finished for you without a hand touching it, except in removing it from one plate to the other; and all you have to do is to screw it upon a wooden block and the thing is done. And what is more, instead of its costing you $30 or $40, the finished picture costs you $1.25! This is the age of experiment, and, as I said, of revolution also. You can afford a great many pictures, and some of the most important newspapers of the country devote themselves to fancy pictures. They have even gone so far as to invent a press which prints pictures in different colors, so they turn out from one machine, without moving the form at all, pictures that are red and green and yellow and all the rainbow. That is pretty expensive, because, as I have said, it requires a special press, and it has to be operated slowly and carefully. But they think that it is a fine thing. There are lots of pictures of men dancing on tight ropes, for instance, and ladies dancing without any tight ropes. [Laughter.] These are supposed to be very popular. I dare say they are. I know of one of the most distinguished newspapers in the country which publishes perhaps an actual edition of 60,000 on week days, but on Sunday it sells 230,000 or 250,000, mainly, as they think, on account of the pictures. Now, I am an old fashioned expert. I don't believe so many pictures are going to be required for any great portion of the next century. It is a passing fashion. It seems to me that it has gone by already to a considerable extent. I asked Mr. Whitelaw Reid one day what was his opinion, and he said he was against these pictures, that they didn't add anything to the purpose of the newspaper, which is to convey intelligence and enlighten thought. Any picture, he said, which is in itself of the nature of news, which gives you the likeness of a distinguished man whose portrait you wish to see, or anything which really illustrates to your mind an event of the day, that is a legitimate newspaper picture. "But the fancy, fantastic devil-to-pay pictures," he said, "those I am not in favor of." I think he is entirely right on that subject, as on many others.

There is one other curious point which I passed over without reflection when discussing the present cheapness of printing paper, and which I will come back to now. It is a pretty interesting curiosity. Paper is so cheap that, supposing you are interested in proving that the circulation of your newspaper is something immense, enormous, you can do it for certain with very slight expense. Having got your plates, your presses, and everything there, you can print a couple of hundred thousand extra papers at a cost which is almost nothing compared to the advertising you may get from it; and then, instead of a circulation of 500,000 every morning, you can show a circulation of 700,000. The utility of that mass of printed papers is not destroyed. They are not sold, to be sure, but their printing is recorded truthfully by the presses, and they show in the figures of your circulation, which the advertisers love to examine. Then you can transport them, so I have heard, let us say to Glens Falls, where we will suppose there is a factory in which they make paper boxes, and you can send your 200,000 sheets, which you have printed for advertising display, and have them brought back to you in the form of paper boxes, that are really useful and may be sold for something. The advertisers are much impressed, but they don't get the boxes. [Laughter.]

I ought to give, perhaps, some facts about the artists who are now employed on so many papers. Many of them are women. Women excel, particularly in drawing fashion pictures, and a clever girl who really has talent will get perhaps $40 or $50 a week as a steady salary. That is, she can have it until she gets married and goes off. The salary of a good artist, who draws whatever is required in a paper, will be from $20 to $100 a week. He makes his pictures so that they can be transferred to the plate, and that is all he has to do. The expense of these pictures greatly varies. The Herald probably spends in preparing its pictures $2,000 to $4,000 a week. They are mostly used on Sunday, though on special occasions they are put in liberally on other days. The Herald prints more pictures, and generally better ones, than any of the other papers.

In the organization of a newspaper there are three kinds of men who are of special value besides the business manager, who is necessarily of the greatest importance. I refer now to three kinds of the intellectual workers, and the first of them that I desire to mention is the reporters. A very good reporter can earn $100 a week, and I suppose that in any well organized newspaper office there are perhaps thirty capable men whose pay will average from $40 to $60 a week, and whose duty is simply reporting. Then there are many others of the sort of reporters who skirmish around and are employed to-day by one paper and to-morrow by another, and are paid for the matter that they deliver. The qualifications of the reporter you cannot estimate too highly. In the first place, he must know the truth when he hears it and sees it. There are a great many men who are born without that faculty, unfortunately. But there are some men that a lie cannot deceive; and that is a very precious gift for a reporter, as well as for anybody else. The man who has it is sure to live long and prosper; especially if he is able to tell the truth which he sees, to state the fact or the discovery that he has been sent out after, in a clear and vivid and interesting manner. The invariable law of the newspaper is to be interesting. Suppose you tell all the truths of science in a way that bores the reader; what is the good? The truths don't stay in the mind, and nobody thinks any better of you because you have told them the truth tediously. The telling must be vivid and animating. The reporter must give his story in such a way that you know he feels its qualities and events, and is interested in them.

Next in importance to the reporter is the man whose duty it is to read the newspapers of this and other countries and take out of them the things that his own paper wants. Mr. Greeley used to say that the exchange reader was the greatest man on the newspaper, and if all the good things were got out of the other papers, it didn't make any difference whatever whether there was anything else or not. But that was going rather too far. Mr. Greeley was a man of delicate humor, and sometimes sought to impress a truth by an apt exaggeration.

Next after the newspaper reader, or exchange editor, as he is sometimes called, comes what we call the city editor. He is the head of the local department. He looks after all the news of the vicinity or locality or town or neighborhood. He employs the reporters and pays them, and he has to be a man of great sense, of alertness of mind, of fidelity to his duty and of untiring industry; and he enjoys also what may sometimes be an advantage, that he is the man with whom all the fault is found. He had no business to have it so.

Then there is the managing editor. He is a gentleman of real importance, of vital importance. He looks after the making up of the paper. He looks after the correspondents; he employs them. He determines how much the correspondent in Paris shall be paid for a particular contribution, and he has to see that everybody under him does his duty and does it at the right time; for a duty done at the wrong time is about the same as a duty entirely neglected.

Then, next to him is, of course, the editor. He is the head of the paper; he determines what its purpose shall be. He determines whether it shall be for prohibition or high license; whether it shall stand by the party in a wrong policy or not. He is the final authority in everything.

Well, now, there is one point that I want particularly to impress upon you young gentlemen, and that is that every one of these men, the reporters, the assistants, the editor, every one of them, while they require the literary and scientific education that I have been speaking of, require also a business education. It is only by being put through the mill of business that a man acquires the science of this world, and knows how to deal with business, and to consider business questions of every kind. I cannot express my sense of this too strongly. In fact, I have always felt—I mention the circumstance merely as an illustration—that the six years I worked in a dry goods store in Buffalo as a boy have been worth to me more as a matter of practical education than some other years passed elsewhere in other pursuits. It is very desirable indeed that the newspaper man, who has to deal with the actual affairs of this world, should know them, and should know them personally. And it is very desirable, also, that he should have that knowledge of human nature which cannot be gained so well, so far as my experience goes, as in a wholesale and retail business establishment.

One of the most interesting things that the editor of a newspaper, or a newspaper maker, has to deal with is the literature of the day, and this includes not merely the books published, but especially what appears in newspapers and magazines, the fiction, the poetry, the fancy articles. The newspaper man ought to be well informed in these things and he ought to have cultivated in himself a sentiment of art and a love of beauty, because the sense of beauty will enable him to judge of all sorts of productions of art, even though he may not be technically and thoroughly familiar with them. There is often expressed an idea that this sort of popular literature is declining in quality, going out in fact, especially the poetry. People often come to me and say that the poetry of the present day is not so good as it used to be when they were youngsters. Well, if you will allow me, Mr. President, to vary the monotony of this dry statement of facts by reading a little poetry, I shall be glad to do it, because I want to show you that there is produced among us to-day as good an article in that line as ever has been produced in the past. First, I would like to read a poem of a rather humorous character. I cut it out of the Hartford Courant:

Under the slighting light of the yellow sun of October,
Close by the side of the car track, a gang of Dagos were working;
Pausing a moment to catch a note of their liquid Italian,
Faintly I heard an echo of Rome's imperial accents,
Broken-down forms of Latin words from the Senate and Forum,
Now smoothed over by use to the musical lingua Romana.
Then the thought came, why, these are the heirs of the Romans;
These are the sons of the men who founded the empire of Cæsar;
These are they whose fathers carried the conquering eagles
Over all Gaul and across the sea to Ultima Thule;
The race type persists unchanged in their eyes and profiles and figures.
Muscular, short, and thick set, with prominent noses, recalling
"Romanos rerum dominos, gentemque togatam."
See, Labinus is swinging a pick with rhythmical motion;
Yonder one pushing the shovel might be Julius Cæsar,
Lean, deep-eyed, broad-browed, and bald, a man of a thousand.
Further along stands the jolly Horatius Flaccus;
Grim and grave, with rings in his ears, see Cato the censor.

On the side of the street in proud and gloomy seclusion,
Bossing the job, stood a Celt; the race enslaved by the legions.
Sold in the markets of Rome to meet the expenses of Cæsar.
And, as I loitered, the Celt cried out, "Warruk, ye Dagos!"
"Full up your shovel, Paythro, ye hathen! I'll dock yees a quarther."
This he said to the one who resembled the great imperator;
Meekly the dignified Roman kept on patiently digging.

Such are the changes and chances the centuries bring to the nations,
Surely the ups and downs of the world are past calculation.
"Possibly," thus I thought to myself, "the yoke of the Irish
May in turn be lifted from us, in the tenth generation.
Now the Celt is on top, but time may bring his revenges,
Turning the Fenian down, once more to be bossed by a Dago."

Now let us hear a strain of a higher note. I found my copy of it in the San Francisco Argonaut. I dare say you have all seen it. It is called "High Tide at Gettysburg:"

A cloud possessed the hollow field,
The gathering battle's smoky shield:
Athwart the gloom the lightning flashed,
And through the cloud some horsemen dashed,
And from the heights the thunder pealed.

Then at the brief command of Lee
Moved out that matchless infantry,
With Pickett leading grandly down,
To rush against the roaring crown
Of those dread heights of destiny.

Far heard above the angry guns,
A cry across the tumult runs:
The voice that rang through Shiloh's woods
And Chickamauga's solitudes,
The fierce South cheering on her sons.

Ah, how the withering tempest blew
Against the front of Pettigru!
A khamsin wind that scorched and singed,
Like that infernal flame that fringed
The British squares at Waterloo!

A thousand fell where Kemper led;
A thousand died where Garnett bled.
In blinding flame and strangling smoke
The remnant through the batteries broke,
And crossed the works with Armistead.

"Once more in Glory's van with me!"
Virginia cries to Tennessee:
"We two together, come what may,
Shall stand upon those works to-day!"
The reddest day in history.

Brave Tennessee! Reckless the way,
Virginia heard her comrade say:
"Close round this rent and riddled rag!"
What time she set her battle flag
Amid the guns of Doubleday.

But who shall break the guards that wait
Before the awful face of fate?
The tattered standards of the South
Were shriveled at the cannon's mouth,
And all her hopes were desolate.

In vain the Tennesseean set
His breast against the bayonet;
In vain Virginia charged and raged,
A tigress in her wrath uncaged,
Till all the hill was red and wet!

Above the bayonets mixed and crossed
Men saw a gray, gigantic ghost
Receding through the battle cloud,
And heard across the tempest loud
The death cry of a nation lost!

The brave went down! Without disgrace
They leaped to Ruin's red embrace.
They only heard Fame's thunder wake,
And saw the dazzling sunburst break
In smiles on Glory's bloody face!

They fell who lifted up a hand,
And bade the sun in heaven to stand.
They smote and fell who set the bars
Against the progress of the stars,
And stayed the march of Motherland.

They stood who saw the future come
On through the fight's delirium.
They smote and stood who held the hope
Of nations on that slippery slope,
Amid the cheers of Christendom!

God lives! He forged the iron will
That clutched and held that trembling hill!
God lives and reigns! He built and lent
The heights for Freedom's battlement,
Where floats her flag in triumph still!

Fold up the banners! Smelt the guns!
Love rules. Her gentler purpose runs.
A mighty mother turns in tears
The pages of her battle years,
Lamenting all her fallen sons!

As long as such things can be produced in the newspapers of the country, there is no danger that the love of art and beauty or the spirit of patriotism can die out. [Loud applause.]

There is one point more, with which I will close. The value of the free press is not now sufficiently appreciated in this country. It is only some particular circumstance, some unusual occurrence, that can make it rise clearly before the eyes of us all. I don't know that I can state it with sufficient distinctness, but in my judgment the highest function of the press is that at last it forms the final barrier which stands between the people and any gross wrong that may be attempted, by a dominant party or by a ruling public favorite. If such a circumstance should ever happen, and God grant that it may not, the mission of the press, lifting its voice in defense of the Constitution and in defense of the spirit of liberty, will be recognized; and the free press will be appreciated as the defender of the public welfare, of the Constitution, and of Liberty itself.

And now let me finish with two or three maxims which seem to me of value to a newspaper maker:

I.—Never be in a hurry.

II.—Hold fast to the Constitution.

III.—Stand by the Stars and Stripes. Above all, stand for Liberty, whatever happens.

IV.—A word that is not spoken never does any mischief.

V.—All the goodness of a good egg cannot make up for the badness of a bad one.

VI.—If you find you have been wrong, don't fear to say so.

There is a tradition in some newspapers of the old school that you must pretend to a silly infallibility, and never admit you have been wrong. That is a silly rule. If a man has not the moral courage to say, Yes, I was wrong, and I don't now believe what I said at some former time; if he has not courage to say that, he had better retire from business, and never try to make another newspaper.

DOMESTIC LIFE IN JAPAN.

By MARY BASIL BROWNE.

A FEW years ago I spent some time in the Far East. Having no pet theories about women anywhere, but having some curiosity about the lot of women everywhere, I very often found myself playing the part of an industrious looker-on.

The window of an inexpensive room I occupied for some months in Tokio, not in the Concession, but in the part where the Japanese live, overlooked a row of small dwellings. Each of these was occupied by a mother and three or four children. The fathers I seldom saw. They seemed to depart very early in the morning and did not return until about dark. My writing table was by the window, and my work was at that time somewhat desultory.

I am within bounds in saying that I sat by that window some six hours a day, and I spent as much of the time in watching the Japanese women and children as I did in applying myself to my work. I went to Japan for a long holiday after some years' hard work out of England, and I took it.

I had no object in watching what went on in those little homes thrown open daily to observation. My work, such as it was, did not concern itself in any way with Japanese affairs. Nor had I the remotest intention of theorizing or reflecting upon what I saw.

It was my first glimpse of the East, my first peep into Asiatic homes. I watched the small people open their shutters and their houses, prepare their morning meal, eat their strange little messes, and drink their pale yellow tea. I watched them clear away and clean up their houses, and then sit down to smoke and rest. They all smoked, down to the little two-year-olds at times. I watched them fondle their children, make for them impromptu toys, nurse their babies, and swing them to sleep in their simple cradles suspended from a beam in the ceiling. I watched them draw water from a common well, and trudge off at times into busier places in their little clogs, bringing back little purchases of food and tobacco.

And I never saw one woman speak or even look angrily at another. There was an easy patience when they took turns at the well, a smiling good nature when one happened to upset the other's tray of grain.

The children played all day. Some, about six or so, had the young babies of their families, tied on to their bare backs, under their kimonos. With little arms and legs outspread, and little body close to and warmed by its elder sister or brother, the baby slept or waked, smiled or wailed a little now and then and was apparently as little heeded by its bearer as the kimono itself.

Running hither and thither, chasing companion or being chased, dodging under projections, through railings, round corners, these little ones seemed always within a shade of damaging the baby, but by no chance ever did so. A kind of hop-scotch was very popular. The baby was jolted and jerked unmercifully, but nobody seemed to mind.

If the baby cried loudly and needed pacification, the bearer stood firm on her, or his, two feet, outhitched up and down in a way that gave a regular rocking motion in an upright direction. If this failed, the infant was carried to the mother, who proceeded to appease it from her abundance. If a man came about, he invariably took the baby in his arms, not as if to spare others indeed, but as his prerogative. On family outings of this class of Japanese—to the park at Uyeno to see the cherry blossoms, or to Meguro to see the peonies—it is always the father who carries the baby. Both mothers and children, as seen from that window of mine, led happy, peaceful, unruffled lives. I never saw them sew or read. They would unpick a kimono, and having spread it on a board, wash it, and dry it in the sun, but I never saw them sew it together again. They were generally occupied. Their leisure was spent in smoking and playing with the children, and, as far as I could judge, they were exceedingly content.

By the accident of some friends happening to come to Tokio I had to quit my seclusion, call at the Legation, and see another side of Japanese life. When I was left alone again, I had the pleasure of seeing the wives and children of some of the Japanese nobles. I was received courteously when I called upon them. Many spoke a little English, some a little French, several very fair German. They seemed much interested in what I told them (in answer to their questions) of strange countries that I had seen. They showed some curiosity about my apparently detached condition. The first question of several was as to the whereabouts of my husband and children, and how I came to be so far from my home alone. And then they told me the number of their children, and one had to remember that this meant the number of children born to their husband, of themselves or of the legal concubines. These last named, who are really in the position of servants in the house, were occasionally to be seen in waiting or with the children. All the children count as those of the legal wife, and one could not distinguish between them as regards dress or treatment.

The faces of these ladies—women whose husbands were shared by other women in the house, openly and honorably as their notions go—were the faces of happy women. It seems clear that to them there is nothing in the least derogatory to their own dignity in this state of affairs. They know no other. "I could not come yesterday, as I had promised," explained a Japanese lady; "we were all very busy, for we had a baby born." No consciousness of anything that could surprise a Western mind.

My stay at Nikko was no pop. globe-trotter's visit. I went out of the season, and settled down a bit there. The wife of the proprietor of what was then called the Nikko Hotel, a Japanese woman of much manners and intelligence, had been for five years in the service of the wife of a distinguished French official. She had in this lady's service twice visited Europe, and she spoke excellent French and very fair English. There came to Nikko two ladies of that class so well known in the West as "of a certain age," or with the young as "old maids." The proprietor's wife begged me to explain what had for some years puzzled her—the existence of such unattached women. "We do not have that in Japan," she said. On inquiry she ascertained that, as far as she knew, there was no such thing as an old maid in Japan. She resented the idea that there should be. She held that their way is infinitely better than ours. "Women in Japan have a happy-timed life," she maintained.

Again, I was for some time shut up by a curious coincidence of circumstances on the island or semi-island of Enoshima. At that time no other Western person happened to be there. I was thrown for society upon the Japanese girls and women of the whole street. I never saw a frown or heard a voice raised. Placidity, often brightening into joyousness, was the note of every Japanese woman I came across. Some of the girls at Enoshima would neglect their household duties to come and talk to me. A messenger would fetch them. Then the neat little messenger would often linger herself and have to be fetched in turn. But never a hasty tone, a sulky look. Whatever they really felt, they all appeared sweet tempered. Every woman was very respectful in her manner and speech to all men, even to men servants. The mistress of a house addresses even her kuruma runner with the prefix of the common honorific term.

It is only since I left Japan that my mind has dwelt at all upon the content of her women. Granted that mine was but cursory observation, I would ask, could a woman live in England or America for one year, in ordinary hotels or boarding houses, moving from town to town, wholly unaccompanied—thrown in consequence of this latter fact upon the services of women everywhere—and not see a frown or hear a voice raised in anger? I trow not.

I have only mentioned three places; my experiences were not limited to these. For about a year I lived in Japan, quite away as a rule from other Westerns, in purely Japanese households, often for weeks seeing none but Japanese, and the conclusion I have come to as the result of my observations of Japanese women is that they are happier in a high degree than women are where Western ideas obtain.

It has since occurred to me to ask whether there can possibly be any connection between their domestic condition and their even temper and content?

Who are the fretful and discontented among English women? They are the "old maids," the wives whose husbands stray away, the women who want to marry and cannot, the women deserted and childless. In Japan all but every mature woman has at least one child. Very often only one, but one is enough to give play to maternal satisfaction. When a man in Japan has more than one wife, some of them are virtually discarded as wives after the birth of the first child. They retain their position as servants of the lady of the house, and they see their baby, the idol of its father, the well cared for and beloved of the nominal mother—but theirs, their very own to cuddle and caress—when they like.

But in England terrible crimes arise as the consequence of maternity when it is irregular, terrible fears eat out the peace of women who are not "straight," terrible penalties attach to the mother of an illegitimate child. In Japan maternity is always an honor and a joy. Women hardly ever live lives of secret intrigue; there is no need; lawful means of satisfying natural desires are open to almost every woman, if my informants spoke the truth. Even the poor girls in the Yoshiwara may be redeemed by honorable marriage. Is there any connection between the frequent unrest and unhappiness of unmated English women and their lot in life?

The question is an interesting one. It is to be remembered that the Japanese women are not intellectual, intelligent, if you like; but if I may judge both from what I have seen and from what people who have lived many years among them say—not intellectual. I do not suggest that the higher type of Western women could ever live as Japanese women live; but for the masses of women, the generality of girls, it seems to me that there is no happiness or content outside maternity, and that honorable maternity should be possible to them.

Of course, nine-tenths of the unhappy among women do not recognize what ails them. Science says that the female is constituted for reproduction. Whatever else she is not fitted for, Nature has generally qualified her for this office.

Are there "old maids" among the trees? Do animals die unmated? Are any of these unchaste? In justice to myself, I may here state that I am the happy wife of a good man, and can, for myself, conceive of no other life than the ordinary married life of the Christian idea. I am close upon fifty years of age; I married when well on in the thirties; am thus qualified to speak from experience of the penalties of some years of "old maidism," so called. I have both before and since my marriage known many women very intimately, notably single women, widows and deserted women. I have conferred a little with happily married women. The result is almost an agony of pity for those who are not and may not be mothers.

I don't pretend to say that any possible way out of the horrible state of things exists. None has, even in the remotest notion of a glimmer, ever appeared to me. But that our system is unnatural, and therefore wrong, the first cause of innumerable crimes, and of more miseries, I am firmly convinced.

Anything that widens a woman's interests, increases her resources, occupies her time, is good for her. She must have no leisure to brood. But again, the wider a woman's interests, the greater her resources, the more alert her faculties, so much the greater danger that she will, on the one hand, awake to Nature's promptings; on the other, suffer from the necessary stifling of them.

I am not talking of young girls. We protect them as long as we can; we who know, by careful up bringing, by provisional measures that shall keep them from knowledge that may suggest or companions that may corrupt. I am talking of women between thirty and forty; say women whose temptations are primarily from within, not from without; women whose chances of marriage are past or rapidly passing. Not such women either as those who read such magazines as the Humanitarian; but our dumb sisters, whose costs them too often all happiness, and sometimes, alas! their reason.—Humanitarian.

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TABLE OF CONTENTS.